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The Institute of British Foundrymen
The Institute of Vitreous Enamellers
The National Ironfounding Employers' Federation
The Welsh Engineers' and Founders' Association
and
The Foundry Trades' Equipment and Supplies Association

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The Coping Stone

The announcement made by Mr. Roy Stubbs, the President of the Institute of British Foundrymen, that the authorities of Sheffield University had decided to create this autumn a degree course in foundry practice was received with enthusiasm by a truly national gathering. The syllabus is now printed and can be obtained from either the Registrar of the University, Weston Bank, Sheffield, or from Professor Andrew, at the Department of Applied Science, St. George's Square, Sheffield.

We can well imagine the old-time moulder reiterating the platitude that despite all the modern technical training systems available, castings are made on the foundry floor and not in the laboratory, but he is the very same individual who but a decade ago raved inconsequentially about "status." During this period a band of enthusiasts has been constantly at work creating, collecting and disseminating technical knowledge germane to his craft. By the organisation of research work, by the publication of technical matter from all over the world, and by the very practical and wholehearted support given to both national and local educational authorities all grades of foundry operatives have had open to them many avenues of knowledge closed to their fathers. All these endeavours have had for their object the improvement of the mental equipment of those engaged in the manufacture of castings, associated with the production of better castings, and those responsible have been quite cognisant of the fact that castings will still be made on the floor, but supervision by men well versed in sand and metal control is a modern essential and if that knowledge is reinforced by skill in moulding technique, so much the better. It is the ultimate creation of this class, which Prof. Andrew has so courageously undertaken on behalf of the foundry industry, and it is now the unquestionable duty of foundry concerns to support the scheme, both financially and by the rapid provision of students and the employment of graduates when the time arrives.

Industrialists and the executive officers are invited to collaborate in the closest possible manner, and Prof. Andrew would welcome criticism of the course he has arranged. His sole desire is to train men of maximum utility to the industry, both on graduation and in after life. Another phase where the co-operation of industrialists is invited is by the employment of students during the long vacation, so that they may experience something of works atmosphere and practical conditions.

The creation of the degree course in foundry practice at Sheffield University places the coping stone on the educational structure so patiently erected through the hard work and enthusiasm of members of the Institute of British Foundrymen.

Testing by X-Rays

When X-rays are mentioned in the presence of a foundryman he immediately thinks of their use for determining blowholes and other structural gaps in castings. In this they serve a very useful purpose, for the material is not destroyed, but a limited purpose because of the technique and cost of apparatus involved. Furthermore, if a founder has to make one-off he cannot afford to risk such defects; if he has a mass-production job then he can afford to break up castings until he finds the best mixture and method of running to give a sound job.

Our recent review of a report published by the National Physical Laboratory reminds us that X-rays have another use, and the report gives illustrations of some of its modern applications, that of crystal analysis, and one which is likely to be used a great deal in research. Briefly, any type of crystal (and most substances are aggregations of crystals) gives its own pattern when examined by X-rays, and any change in the arrangement gives a change in the X-ray pattern. A study of the pattern enables deductions to be made as to the nature of the arrangement. X-ray analysis can, in fact, disclose whether a material is crystalline or amorphous, and give the size of the crystal, its orientation and perfection. It discloses the effects of heat, work and other treatments. It enables the investigator to say whether a given material is a mixture or a solid solution, whether impurities are present and if so, what they are.

To give some illustrations, the examination of certain boiler-tube scales showed that in some places the scale was Fe_2O_3 and in other places a mixture of Fe_2O_3 and Fe_3O_4. The method has been used with great advantage in examining chromium-plated deposits, and showed the size and type of crystal which gives a brilliant deposit. It has disclosed differences between natural graphites and ordinary carbon blacks. Finally, metallurgists once believed that iron had three allotropic modifications, known as alpha, beta and gamma, existing at differing temperatures. This type of analysis showed beyond dispute that alpha and beta irons have the same crystal structure, while gamma iron has another type of crystal. Thus while alpha and gamma are different types, the former a body-centred cube and the latter a face-centred cube, alpha and beta are not allotropic modifications as usually understood. Delta iron, which is a modification discovered later to exist at higher temperatures than gamma, has a crystal structure the same as alpha and beta. Doubtless the authorities are keeping an eye on the possibilities of this type of examination for cast structures.

C

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Cupola Practice

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—If I may again trespass on your valuable space I would like to deal with the points raised in Mr. Neville's letter, as published in your issue of June 7, in which he has discussed some of the facts and opinions expressed in my last letter.

It is obvious that the gases formed in the zone of the balanced-blast cupola hearth lying between the horizons of the valved main tuyeres and of the bottom row of auxiliary tuyeres must have compositions varying between that of air and that of the carburised air whose CO_2 and CO contents are influenced by the adjustment of the air-control valves on the main tuyeres. In my early experiments I attempted to produce, by the valve adjustments, a gas in the zone of the bottom auxiliary tuyeres—of the neutral type described.

It was found possible to approach the ideal gas condition such that, with suitably spaced and grouped auxiliary tuyeres of proper area, the CO in the gases arriving at the level of the bottom row of auxiliary tuyeres was partially burnt to CO_2—the remaining CO being burnt to CO_2 by the supplementary air supplied through the upper row or rows of auxiliary tuyeres.

The depth of the zone in which the desired neutral gas appeared varied with different cokes, even when the air supply was kept constant (volume and pressure), and it was soon evident that the main tuyere-air control valves were requisite for balancing the air supply between the bottom main tuyeres and the group of upper auxiliary tuyeres.

Whilst this adjustment and balancing of the two sections of air supply enabled efficient combustion to be attained with the minimum of trouble—irrespective of the quality of the coke (within reasonable limits)—the further function of the air-control valves on the main tuyeres in enabling the minimum air supply to be used, with a reduction in the charge coke, has been proved in more recent instances as of great importance.

In discussing the influence of different ratios of main-valved to auxiliary tuyeres, Mr. Neville has only considered the cases where the air flow (lbs. per minute) is constant, involving great variations in the air velocity through the tuyeres when the main-tuyere valves are adjusted from full open to one-fifth of full open positions. These conditions are not approached in practice where, if the minima of metal oxidation and of coke consumption are to be obtained, *the rate of air flow must be varied and the air velocity through the tuyeres kept within a reasonably narrow range during the blow.* It is here that the older fixed size of main tuyeres fails to provide a means for finding out whether, with the usually accepted air volume and pressure valves, really effective melting is in process and the coke bed functioning correctly. If severe oxidation is taking place at the tuyere mouths, due to excessive air flow, with no other means of checking it except that of partly closing the main blast valve and unduly reducing the air pressure in the wind belt, there is always the danger lest the attempted remedy has vitally disturbed the position of the melting horizon in the coke bed.

May I, finally, deal briefly with the seven points raised in the closing paragraphs of Mr. Neville's letter?

(1) The depth of the coke bed in the balanced-blast cupola is generally deeper than in the ordinary furnace, but in many cases of conversion the weight of bed-coke burnt during the blow is less than in the older cupola practice. The Figs. 1 to 4 show the top of the coke bed much above the top row of auxiliary tuyeres. The usual level is that of the middle row of auxiliary tuyeres.

(2) and (3) The greater proportion of the air supplied does enter at the lower tuyeres, these being so proportioned that an excessive amount of air does not pass up the cupola near the walls, the form of the lining being such that the hot gases can expand easily as they approach the bottom row of auxiliary tuyeres.

(4) It has been considered more important to reduce the free oxygen content in the hearth gases in the zone lying between the valved tuyeres and the bottom row of auxiliary tuyeres than to increase the CO content in the gases traversing the upper half of the coke bed. The highly superheated metal flowing past the bottom row of auxiliary tuyeres would be more readily oxidised by any free O_2 there (if present) than by CO_2 in the upper, and cooler, part of the coke bed.

(5) The reason for the use of the valved tuyeres has been explained. Whilst a reasonable control of the coke lump size is desirable the use of small coke in the cupola coke bed is still a debatable matter, especially as influencing the air supply as controlled by the valved (bottom) tuyeres.

(6) It has been previously stated that it has been possible to obtain almost complete combustion of the coke carbon to CO_2 as shown in low-temperature top gas analysis, when the cupolas have been melting at the normal rate of 0.75 ton per hr. per sq. ft. of bore area at main valved tuyere level. The spacing of the auxiliary tuyeres has proved effective for this rate of melting. At higher rates of melting there is a tendency for the coke consumption per ton of iron melted to increase—higher top-gas temperatures accompanying excessive air supply.

(7) If, in special cases, metal oxidation is likely to be particularly detrimental, the CO content in the upper portion of the coke bed can be readily increased by the use of smaller auxiliary tuyere area but, as there is an increasingly urgent demand for a low-carbon pick-up in melting, any increase in the CO content in the coke-bed gases—with increased coke consumption and tendency to lower temperature metal—is generally avoided.

I very much appreciate the spirit in which Mr. Neville has been pleased to criticise the facts and opinions expressed in my last letter, published in your issue of April 5.—Yours, etc.,

J. E. FLETCHER.

Netherton Iron Works,
Dudley.
June 18, 1934.

"Fettling" the Cupola

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—We are very interested in the query "'Fettling' the Cupola," appearing in your issue of June 14.

There should not be the slightest difficulty in repairing this cupola, as if it is working under reasonable conditions it should not burn out more than to 2 ft. to 3 ft. above the tuyeres, and if the tuyeres are, say, 2 ft. to 2 ft. 6 in. from the bottom of the cupola, it should be quite possible for the cupola man, when standing on a small board put from the cleaning door across the bottom of the cupola, to reach up and repair the cupola to the required height.

It is quite possible that this cupola may be working with too much blast, and so getting very dirty, which will cause it to burn out higher up, consequently the additional repairs necessary; but if C. F. cares to let us have particulars, we shall be pleased to give him any assistance we can to enable him to overcome this difficulty.—Yours, etc.,

For and on behalf of
Robson Refractories, Limited.
J. H. COOPER,
Managing Director.

47, Coniscliffe Road.
Darlington.
June 18, 1934.

Random Shots

CORRESPONDENCE.

[No responsibility accepted for the statements made or the opinions expressed by "Marksman's" correspondents.]

DEAR "MARKSMAN,"—I fear that you have been consorting with Miss Snookers at a far more dangerous hour than a morning session—to whit, 1 a.m. There *was* a session of cabaret when all the old favourites were rendered except the "Muffin Man," that being considered too dangerous for the Grand Hotel's supply of glass. But none of us will forget "On Ilkla Moor Baht 'At" given in a deep Bass voice by one who is very prominent in our Councils in more senses than one. The beauty chorus sang with great *spirit*, not being in the least put out by the odd half-tone to which you take such exception. I can only conclude that your remarks arise from the jealousy which notably exists among all great singers.—Yours, etc.,

"ONE COOK."

* * *

DEAR "MARKSMAN,"—Your bare-faced effrontery is even greater than a Noo Yark newspaper reporter's. You could not have spent the morning of the second day of the conference in my company for the simple reason that I was not in Manchester. I find it so difficult to make a personal appearance at any time, as you know. The truth of the matter is, I expect, that you do not know where you did spend that morning. Probably in your bedroom with an extra-large bottle of aspirin.—Yours, etc.,

N. SNOOKERS.

Catalogues Received

Foundry Coke. A folder received from Bearpark Coal & Coke Company, Limited, 20, Royal Exchange, Middlesbrough, is particularly intelligently presented. An aggregate of nine labelled diamonds imposed on a piece of coke, plus a few external phrases, disclose all the germane information a foundry can desire. We can only think of one additional piece of information that might be given, and that is "carbon pick up," which seems to vary from coke to coke.

Sand Reclamation. A leaflet received from Colbond, 24, Martin Lane, Cannon Street, London, E.C.4, draws attention to a plant manufactured by International Combustion Engineering Company, Limited, of Derby, for them for the purpose of screening out the detrimental fines and coarse material. The cost of this is stated to be but a few pence per ton. Any plant designed to improve the level of sand control in British foundries deserves and demands the closest attention from every executive within the industry.

Iron and Steel Output

The British Iron and Steel Federation reports that there were 101 furnaces in blast at the end of May, a net increase of three since the beginning of the month, four furnaces having gone into blast and one furnace having ceased operations. Production of pig-iron in May amounted to 527,900 tons, compared with 496,300 tons in April and 339,900 tons in May, 1933; the daily rate showing an increase of 3 per cent. compared with the previous month. The production includes 133,300 tons of hematite, 264,400 tons of basic, 104,700 tons of foundry and 9,000 tons of forge pig-iron. The output of steel ingots and castings amounted to 780,000 tons compared with 716,800 tons in April and 599,600 tons in May, 1933.

The Institute of British Foundrymen

ANNUAL BANQUET AND DANCE AT MANCHESTER

The Institute's annual banquet and dance was held on the evening of Wednesday, June 6, at the Midland Hotel. The President and Mrs. Stubbs received the members and guests, who included the Rt. Hon. the Lord Mayor of Manchester (Alderman Joseph Binns, M.B.E.) and the Lady Mayoress, the Rt. Hon. the Lord Stanley of Alderley, Mr. J. S. Peck (Metropolitan-Vickers Company, Limited), Mr. Sterry B. Freeman, C.B.E., M.Eng. (chairman, North-Western Branch, Institution of Mechanical Engineers), Mr. M. E. Stubbs (chairman of Messrs. Joseph Stubbs, Limited), Mr. W. N. Cook, B.Sc. (President of the Lancashire Branch), Mr. A. Phillips (chairman of the Conference Committee), Mr. J. E. Cooke (Hon. Conference Secretary), Mr. T. Makemson (general secretary of the Institute), Mr. C. E. Williams (Immediate Past-President) and Mrs. Williams, Mr. F. J. Cook (Past-President), Mr. J. Cameron (Past-President) and Mrs. Cameron, Mr. J. T. Goodwin (Past-President) and Mrs. Goodwin, Mr. V. C. Faulkner (Past-President) and Mrs. Faulkner, Mr. V. Stobie (Past-President) and Mrs. Stobie, Mr. J. E. Hurst (Senior Vice-President) and Mrs. Hurst, Mr. H. Winterton (Junior Vice-President) and Mrs. Winterton. A number of representatives of allied bodies were also the guests of the Institute.

The Toasts

The loyal toast having been honoured,

The RT. HON. THE LORD STANLEY OF ALDERLEY, proposing "The City and Trade of Manchester," said it would be invidious to contend that the toast was the most important to be honoured that evening, and he would not make the contention, because by so doing he would invoke serious rebuffs from subsequent speakers; but if it were not the most important it was at least a very important toast. When a small boy he had been taught that Manchester was the second greatest city in the British Isles. He did not know whether that was still true as regards size, but he had no hesitation in saying that, for a multitude of reasons, Manchester was not the second greatest city in the British Isles, but the greatest. Two of those reasons were implied in the very name of the toast; Manchester was the greatest from the point of view of a "city," a word which implied civic pride, and in many ways it was the greatest of our trading centres. It was the fourth largest port in the Kingdom—and its seaborne trade was but a tithe of the whole of its trade. If the figures of the total trade of Manchester, both seaborne and internal, were available, he believed it would be found that Manchester was the greatest trading city in the country; and that, he would like to believe, meant that it was the greatest trading city in the world.

Trade and Tariffs

But, alas, the trade of Manchester is not now what it was. There were many reasons and factors operating, some of them being under our control. The city of Manchester was perhaps most remarkable for its enterprise in having built at the end of the last century the Manchester Ship Canal, and its cost, he believed, was upwards of twenty million pounds sterling. Its object was to enable us to render goods, and all the necessities of life, as cheap at the point of consumption as at the point of production, or almost as cheap, to bring wealth (by which he meant goods) from the four corners of the world to Manchester as cheaply as possible. For many years the Manchester Ship Canal had fulfilled that object in the most admirable fashion. But, alas, during the last few years trade in this country, as, indeed, all over the world, had been slipping from us, with the result that the sound common sense, that rock bottom of commercial integrity which had existed in Manchester, began to seek anew for different gods to worship, and we had the melancholy spectacle of goods being made cheap at the point of production—which in this case was Manchester, the centre of one of the largest industrial areas of this industrial nation—and then rendered more expensive by artificial means. We had set up around our shores an army of officials, of red tape, men who, for aught he knew, had bayonets, swords, revolvers and guns—the Inspectors of His Majesty's Customs—and on everything that came through the Manchester Ship Canal, and which the citizens of Manchester wished to make cheap, we raised artificial barriers to make them again more expensive. We had, indeed, overcome the great obstacles of nature. We had built railways and great roads, we had tunnelled through mountains, we had improved our fuel and had made more efficient ships, with the end of cheapening goods and rendering wealth more available to our people; and at the same time we placed man-made artificial barriers in the way. That was why the trade of Manchester was not so healthy as he wished to see it.

The Foundry Industry and Cotton

Manchester was the centre of the cotton industry; but it was also far more than that. Manchester and the country around it was, to use a vulgar phrase, the guts of the whole works, and the foundrymen and engineers were representative of that guts. How could we spin cotton without looms and other machinery, and how could we create machinery without the foundryman to cast it? The fact that the first meeting of the Institute was held in Manchester, in 1904, indicated that Manchester then, as now, was in the forefront of industrial development in this country. Manchester had realised what a future lay before her in the foundry business. It was true to say that, without the foundrymen, industry would founder; indeed, it could be said that the foundrymen's business was the foundation of all industry.

In short, one found in Manchester an active-minded body of citizens, thinking constantly of the benefit of the greatest number of the inhabitants. They were well to the fore in all modern developments. Constantly he had cause to thank Manchester for its foresight in establishing an admirable airport.

Finally, Lord Stanley coupled with the toast the name of the Lord Mayor, and commented upon the great ability with which he led the progress and the civic pride of the city.

The RIGHT HON. THE LORD MAYOR OF MANCHESTER, responding, first voiced the pleasure it afforded him to welcome the members of the Institute to the City of Manchester, for they represented an industry which rendered considerable service in the city, and it was the industry in which he had first endeavoured to make his fortune. Unfortunately, he had become a Lord Mayor instead, and the disastrous consequences of personal ambition would be appreciated.

As a Manchester-born man, however, he was proud of the achievements of the men of that city. The founder of the atomic theory was John Dalton, who was a teacher at Owen's College and a respected member of the Manchester Literary and Philosophical Society; John Dalton had fixed a basis upon which scientists could calculate to a closer degree than they had ever done before the possibilities of natural resources and the powers that came about by true chemical combination and dissection. Again, Joule had laid down a mechanical law which stood to-day. At the University and Owen's College there was pride in the achievements of the long line of men who had been pioneers—men such as Prof. Lord Rutherford, who was endeavouring to find an even smaller fundamental than the electron.

But he regarded Manchester also from another point of view. He believed, as did Lord Stanley, that Manchester would go forward again, and he was not so despondent about the present situation as were many people. A few of the industries of Manchester were fairly active. The engineering industry had become considerably better than it was six months ago; the textile industry was not slumping terribly at the moment, though it was bad. There were other industries which were doing fairly well, and, given an opportunity, by the removal of some of the restrictions which had been mentioned, he claimed that Manchester would very largely come into its own again during the period of the next three years; at least, he hoped so.

Sheffield University Foundry Course

There were many reasons why he was glad to be present at the Institute's dinner. He recalled that in 1898 he was a student at the College of Technology, where there were classes on iron-founding—the first in Great Britain, he believed. He was proud to be able to say that since then the Institute had come into being, and that similar institutions had been inaugurated in the various sections of the engineering and other industries. The result was that to-day we were becoming the most scientifically organised people in the world. Information obtained in one direction was commonly distributed to those interested for the purpose of raising our industries to a higher level than they had occupied before. The opportunities for using the universities had become more common in all scientific industries, and he was proud that the Institute had decided to set up a Degree Course in Founding at Sheffield, because in his opinion the foundry craft was a high scientific profession. The dangers that had existed at the time he had started in the industry had been largely diminished by reason of scientific investigation, and foundrymen undertook their work with a measure of knowledge which led to the finest results and raised everything to a much higher pitch of perfection than formerly. Manchester, as a large foundry centre, was pleased to welcome the Institute, particularly with Mr. Roy Stubbs as President. He was a member of one of the oldest foundry families in Manchester—and the Lord Mayor recalled that he had known the three brothers for many years. Messrs. Joseph Stubbs, Limited, had always had the respect of the men when negotiating, and when there was any trouble they had fought the matter out and had shaken hands afterwards.

Finally, the Lord Mayor expressed the hope that the Institute would continue to help forward the education of future foundrymen, so that the country would rise to greater skill and greater eminence and maintain its great share in the control of the world's work.

MR. J. S. PECK, who had accepted at short notice the task of proposing the toast to the Institute, owing to the fact that Mr. E. J. Fox, who had intended to propose it, was prevented by illness, suggested that the gathering might send to Mr. Fox a word of goodwill and an expression of the hope that he would soon be restored to health.

(This suggestion was heartily approved.)

Continuing, Mr. Peck said that as he looked around at the prosperous people seated at the tables he felt that he had made a mistake in his choice of profession! As an engineer, he

had always been in close proximity to a foundry. Thus he could appreciate the troubles and difficulties of the foundryman, and he could also appreciate the difficulties, the expense and the delays to which the engineer was put when the foundry delivered defective castings to the machine shop! But so seldom did the machine shop receive castings filled with blowholes that perhaps, when such castings were received, the people in the machine shop were a little more critical than they should be when they remembered the moulders' difficulties.

Competition from Weldings

But a serious competitor to the foundrymen had arisen; those who had visited the Metropolitan-Vickers works that day and had seen the enormous progress that was being made with fabricated steelwork would appreciate it. It was developing at a very rapid rate indeed, and if he owned a foundry he would find a corner in which to put down a fabricating department, a small one to start with, so that he could test out the possibilities of fabrication, and, if it did develop to the extent that appeared probable to-day he would be able to share in the development. He did not consider for a moment, of course, that the foundry had finished, because there would always be a demand for certain types of castings, whatever developments were made in weldings. It had been his experience that no industry so firmly established as was the foundry industry ever succumbed quickly. For example, we had been told that the electric locomotive would soon supersede the steam locomotive; yet the introduction of the electric locomotive had acted merely as an incentive to the designer of the steam locomotive to effect improvements, and he had improved the steam locomotive almost beyond recognition. The steam turbine had to a certain extent superseded other types of prime mover, but the reciprocating engine was still being built in large numbers; and he was told also that more candles were being manufactured to-day than was the case a hundred years ago. Competition tended to increase efficiency. He believed that, whatever the competition might be, a strong and virile organisation such as the Institute of British Foundrymen would rise to meet it, no matter from what part of the world it might arise.

We were entering on a period of better times, and he ended by wishing prosperity to all, and to the Institute in particular. He coupled with the toast the name of the President.

The PRESIDENT, who was greeted with prolonged applause when he rose to respond to the toast, first expressed the Institute's thanks to Mr. Peck for having suggested sending a message of goodwill to Mr. Fox; indeed, it was the intention to do so. The President added that he had been looking forward to hearing Mr. Fox say that he came to this function not as an iron-founder but as a manufacturer of pig-iron. He was disappointed, also, that he had not the opportunity to tell Mr. Fox that Messrs. Joseph Stubbs, Limited, had bought pig-iron from his company in 1896 at 47s. a ton, or to try to convince him that if he could offer similar iron to-day at the same price the miserable iron-founder could make some profit, and the Stanton Iron Company would treble its profits within the next twelve months.

One was impressed with the thought that all thoughts for the future were based on helping the industry, and he believed the 31 years of service rendered by the Institute to British foundrymen placed an obligation of membership upon any man who expected to make founding his life work. All were welcome; the members realised that the Institute had a proud record of accomplishment, and if this fact were broadcast many of the thoughtless ones would realise that the Institute was entitled to their support. It seemed that there should be an increased membership in the future, and that the Institute would then accomplish even far more than in the past. All the existing members, by their willingness to give of themselves without stint and by their unselfish devotion to the interests of the Institute and of the industry, had made association with them a very great privilege. His plea was that they should avail themselves fully of the facilities which the Institute had to offer, and help it to grow and become more useful by their participation, interest and effort.

It would be churlish on his part if he did not express very sincere gratitude to the chairman of the company, with which he had the honour to be associated, and also to his co-directors, for their kindness to him, because without their support, both moral and physical, he would not have been able to occupy the proud position of President of the Institute. Therefore, he paid tribute to them, and he also expressed grateful thanks to the members of the staff, because the periodical absences from the business, which his Presidential office would entail, would throw extra work upon them.

Finally, the President voiced his personal thanks and those of the Institute to Mr. Peck for the kind manner in which he had proposed the toast.

The Visitors

MR. W. N. COOK, B.Sc. (President of the Lancashire Branch) proposed a toast to "The Guests," and spoke of his good fortune in occupying the presidential chair of the Branch at this time, for it carried with it the privilege of proposing the toast. A conference such as this, he continued, would be impossible without the co-operation of many people, not the least of whom were the Lord Mayor and other leading citizens of the city and the executives of the principal works in the district. It was a pleasure to entertain these gentlemen and their ladies and to convey to them in person the Institute's deepest thanks for their valuable co-operation. The Institute had been honoured both in the morning and in the evening by the presence of the Lord Mayor, in spite of his multitudinous duties, and it was an added pleasure that the Lady Mayoress was able to accompany him. The Lord Mayor understood the industry thoroughly, and perhaps one might take the opportunity to point out that the Institute would be delighted indeed to enrol him as a member if at any time he should decide to return to the industry.

Mr. Cook also paid a tribute to Lord Stanley, whose distinguished father and illustrious grandfather were honoured not only in the Manchester district, with which they were so intimately associated, but throughout the country, for their services had earned them the respect of the country as a whole. Everyone was glad that Lord Stanley was following so worthily in their footsteps, and it was fitting that he should have proposed the toast to the city, for he had already shown himself willing to take an active part in the governing thereof, and it was hoped that his services, so willingly offered, would be willingly accepted.

Again, the Institute was deeply indebted to Mr. Peck, who had at short notice accepted the task of proposing a toast. He was a noted electrical engineer, and a director of the branch of the Metropolitan-Vickers Electrical Company, Limited, at which some of the members had been entertained so magnificently. Another honoured guest was Mr. Sterry B. Freeman, representing the Institution of Mechanical Engineers, one of the largest and most important of all the engineering and scientific societies. He had achieved no mean fame as a marine engineer. It was also a pleasure to welcome the representatives of various firms which had co-operated to make the conference so great a success, and they included Mr. M. E. Stubbs, the chairman of Messrs. Joseph Stubbs, Limited; and the representatives of kindred associations and societies.

The name of Mr. Freeman was coupled with the toast.

MR. STERRY B. FREEMAN, C.B.E., M.Eng., M.I.Mech.E. (Chairman, North-Western Branch, Institution of Mechanical Engineers), responding to the toast, said he was speaking, for the first time in his life, to a "mixed constituency." Speaking of the Institute, he commented on the fact that it was remarkably well run, and said that whereas things which were left to run themselves ran down-hill, this body was going up-hill, under the care of its officials. Its guests would carry away happy recollections of the delightful manner in which they had been entertained.

It was said that the raw material of the foundrymen was liquid iron, but it was obvious that another raw material they dealt in was brains; and, as the ladies were present, he would like to add that another raw material was sense. We had seen a good deal of brains, sometimes rather over-developed, among the intelligentsia, the people having all brains and no sense; inasmuch as the ladies were present on this occasion, one felt there was a balance which was sometimes lacking.

This concluded the speeches, and the remainder of the evening was devoted to dancing, which continued until a late hour.

SOCIAL ACTIVITIES

On Thursday evening, June 7, a dance was held at the Grand Hotel, at which over 200 members and ladies were present. At intervals, Mr. Graham Adams, the Manchester entertainer, performed amusing conjuring tricks, and gave a wonderful memory exhibition.

During an interval, the President, Mr. Roy Stubbs, took the opportunity of acknowledging the services which had been rendered in connection with the organisation of the Conference. He said that, in forming a Conference Executive Committee, it was very important to have the right man as chairman, and they had been fortunate in that Mr. A. Phillips had served in this capacity. Splendid service had been given by other members of the Committee, Messrs. W. N. Cook and R. A. Miles, and they were particularly indebted to Mr. J. S. G. Primrose, who had prepared the excellent souvenir booklet.

Work of the Ladies' Committee

The Ladies' Committee had worked assiduously, and had had complete charge of the ladies' programme. Furthermore, they had made a very graceful gesture in presenting the badge for the use of the wife of the President. Considerable assistance had been rendered by the general secretary and his staff, and they were also indebted to Mr. Ben Haigh, who had devoted a portion of his holidays to rendering secretarial assistance. He also felt that he must pay tribute to the devoted work of his wife. Mrs. Stubbs had been an admirable chairman of the Ladies' Committee, and he, personally, owed very much to the encouragement and support which she had given to him during the period of preparation of the Conference.

Presentation to Mr. and Mrs. Cooke

Finally, it was with the greatest pleasure that he extended the thanks of everyone present, to Mr. J. E. Cooke, the Conference secretary, Mrs. Cooke and Miss Joyce Cooke. Mr. Cooke, his wife and daughter, had carried out the secretarial work, much of which was unseen. They had done it with praiseworthy devotion, and it had been carried out exceedingly efficiently. No one could express the Institute's indebtedness to them for the valuable part they played in the organisation of the Conference. On behalf of the Conference Committee, the President then presented a clock to Mr. and Mrs. Cooke as a slight recognition of the appreciation that was felt for their services, and as a memento of the Conference.

MR. J. E. COOKE, who was received with loud applause, thanked Mr. Stubbs for his very kind remarks regarding the work of himself, wife and daughter, and thanked the Conference Committee for the very handsome memento. Such

(*Concluded on page* 400.)

Recent Developments in British Synthetic Moulding Sand Practice*

By John J. Sheehan, A.R.C.Sc.I., A.I.C.

The title of this Paper is based on experience gained mainly in converting the sand systems of a mechanised foundry from natural moulding sands to the use of synthetic-moulding sand. The foundry operates a fully-mechanised grey-iron system making automobile cylinders and pulled tops, rat-tails, ripples, but as these are more nearly related to coal-dust content and quality rather than to basic sand condition, a discussion of them is not included.

As the tabulated possible conditions giving rise to the defects mentioned could not exist at one

Location.	Sands in Use.	Method of Preparation.	Existing Sand Conditions.
Jobbing floor	Red sand, from the Bunter deposits	Panless mixer	Satisfactory
Grey iron system	Red sand and Belgian yellow sand	Raised-roller mixer ..	Very unsatisfactory.
Steel system	Belgian yellow sand ..	Raised-roller mixer ..	Satisfactory, but capable of improvement.

heads, a partially-mechanised steel system making automobile parts and a jobbing floor. The subject-matter of the Paper may be conveniently dealt with by considering it the solution of the problem of this "change over" and the adaptation of the change to the three systems. The problem, stated more specifically, was to develop a moulding sand that would operate successfully as a grey iron, a steel and a jobbing floor sand, and further to make the basis of this sand, burnt sand which has already functioned in oil-sand cores.

Apart from the economy suggested by this scheme, the trouble experienced in the use of natural moulding sands demanded thorough investigation and rectification, and was an additional incentive to change.

The conditions existing prior to the change may be summarised briefly in the above table.

Attention was of necessity centred on the grey-iron system and investigations begun into the sand system as such and into the sands used, keeping in view the needs of the other systems and possible economies.

As previously stated, the grey-iron system is fully mechanised. The sand preparation and distribution "lay-out" is detailed diagrammatically in Fig. 1.

The sand-preparation plant consists of two raised roller mixers, a distintegrator and a magnetic pulley. The distribution is by rubber-belt conveyors and the storage by overhead hoppers, one large hopper for spent sand over the mixers and a series of smaller hoppers over the moulding machines for the prepared sand. This system is simple and looks effective, but failed absolutely to prepare and deliver natural moulding sands in a condition suitable for good moulding, more particularly for good machine-moulding.

The scrap, due to sand defects at this particular period, was excessive and certainly diversified—dirty castings, broken moulds, dropped moulds, leaking castings, due to sand inclusions on thin sections, scabbed castings, swollen castings—and an exhaustive examination of the sand as delivered by this system revealed the cause and led ultimately to the cure.

The statement "the sand as delivered by this system" is deliberate, and is used to avoid at this stage apportioning the responsibility for the defective condition of the moulding sand, as between the system and the chemical and physical composition of the sand as received.

It is more convenient first to tabulate the defects and the conditions causing them (Table I).

MR. JOHN J. SHEEHAN.

General Remarks on Table I

There are many more types of defective castings associated with sand condition, such as and the same time in the sand, those that actually obtained at the time of the investigation are italicised, and to simplify the reference the physical constants of the moulding sand then in use are given below.

Strength, 13 to 15 lbs. per sq. in.
Permeability, 30 to 32.
Moisture, 4 to 5 per cent.

Old Type Mill.

Sample.	Moisture.	Permeability.	Strength.	Clay.	Sand.	In pan.	Fineness No.	Clay.	In pan.	Permeability.	Strength.
				Per cent.	Per cent.	Per cent.		Per cent.	Per cent.	Per cent.	Per cent.
Untreated ..	—	—	—	4.6	95.4	2.0	87.7	—	—	—	—
Lab. treated ..	—	—	—	6.9	93.1	3.2	100.2	—	—	—	—
Milled 4 min. ..	—	—	—	12.1	87.9	4.3	105.6	+ 75	+ 34	— 25	+ 53
				Raised	*Roller*	*Mixer.*					
Untreated ..	—	—	—	4.7	95.3	4.7	104.8	—	—	—	—
Lab. treated ..	4.6	35	7.0	8.1	91.9	4.3	104.8	—	—	—	—
Aver. from mill	4.6	32	10.0	11.9	88.1	4.3	104.5	+ 47	Nil	— 8.6	+ 43
From under rollers ..	4.7	28	11.0	13.6	86.4	4.9	106.3	+ 68	+ 14	— 20	+ 57

The outstanding deficiencies of this sand are low permeability and high strength. The low permeability effecting the sand condition directly and the strength indirectly in that the high clay content giving this strength compacted the sand so thoroughly that it caked at the bottom of the mill and the rollers rode over the compacted mass. Inefficient mixing was the result. Inefficient or irregular aeration also resulted as the disintegrator was unable to break up this caked mass.

The sand was composed of 18 parts red sand and 14 parts of Belgian, 22 parts of old sand; this mixture is obviously wrong, and, briefly, for the following reasons:—(*a*) Excessive amounts of new sand, and (*b*) the smaller grains of the red sand fitting between the grains of the Belgian and giving an almost impermeable mass. It would be unfair to the sand-preparation system to consider it inefficient when unable to prepare satisfactorily such a mixture.

However, operating the system on a single naturally-bonded moulding sand was also unsatisfactory, though not to the same extent. The mixers were incapable of breaking up the coarser clay pellets in the short time demanded by the mechanised moulding equipment. This is illustrated by Fig. 7, showing the condition of unbroken clay pellets fused in the sand mass.

Actually 50 tons of backing sand per 8-hour day are required by the moulding section, and the mixers are capable of holding 644 lbs. per batch, allowing only 2½ minutes for mixing each batch.

The inability of the raised-roller type faster-working mixers to handle a heavily-bonded natural moulding sand is also demonstrated by the following set of figures and gives a comparison also with the older type heavy-roller mixer used on floor moulding.

The increase in strength after 4 minutes' milling in the old-type heavy-roller mill was 53 per cent. against an increase of 43 per cent. for the newer mixer. Evidence of incomplete mixing is also strikingly shown, the strength figures for the average from the mill being considerably less than that portion of sand compacted under the rollers.

The rectification of these two major defects, the sand condition and the inability of the mixers to function rapidly was made possible by a simple adjustment to the sand mixture, using one to two parts Belgian sand and one part Southport sand; this gave the following physical constants:—

Facing Sand.		*Backing Sand.*	
Permeability ..	46.0	Permeability ..	57.0
Strength	8.6	Strength	5.7
Moisture	5.0	Moisture	4.0

This alteration raised the permeability, lowered the strength and thus allowed the mixers to function without compacting the mass; in fact, the rubbing of the grains of Southport through the Belgian sand efficiently broke up the whitish clay pellets naturally occurring in the latter sand; the disintegrator also functioned excellently, no choking-up occurring. The raised-roller mixers now worked most efficiently and rapidly. In fact, they were ideally suited for the high-speed quantity-production sand system.

This semi-synthetic sand functioned in the system excellently, and the improvement in the scrap from sand defects was most marked, as is

* A Paper read before the Annual Conference of the Institute of British Foundrymen held at Manchester, June 5 to June 8.

shown in Table II. This concluded the first stage of development, and while maintaining these good conditions with this semi-synthetic sand, investigations were continued, to determine the attributes necessary to good moulding sands for steel, grey iron and jobbing-floor work.

No effort was made further to utilise the red sand in the systems. A thorough analysis of this sand revealed its unsuitability, but undoubtedly also yielded much interesting information which may be ultimately utilised in synthetic-sand practice.

The red sand under discussion is Bromsgrove red, and is typical of the sands of the Bunter deposits. The chemical analysis of this sand is as follows:—

Ignition loss	1.00 per cent.
Silica (SiO_2)	86.70 ,,
Iron oxide (Fe_2O_3)	1.60 ,,
Alumina (Al_2O_3)	6.3 ,,
Titania (TiO_2)	0.2 ,,
Lime (CaO)	0.3 ,,
Magnesia (MgO)	0.3 ,,
Alkalies (Na_2O K_2O)	3.4 ,,

and the mechanical analysis (Tylor screen):—

+ 35 mesh	0.2 per cent.
+ 48 ,,	1.2 ,,
+ 65 ,,	8.6 ,,
+ 100 ,,	34.0 ,,
+ 150 ,,	26.2 ,,
+ 200 ,,	14.9 ,,
+ 250 ,,	5.2 ,,
− 270 ,,	3.2 ,,
Clay	6.5 ,,

The chemical analysis of similar sands from the same Bunter deposit (Table III) is included to illustrate the type (figures taken from Table III of a Memoir on "British Resources on Refractory Sands," by P. G. H. Boswell, O.B.E., D.Sc.).

The value of these sands lies in their regular occurrence. For high-temperature work, such as automobile cast irons and steels, their disadvantages are numerous, because (1) they contain between 2 and 3 per cent. of potash, thus rendering them easily fusible at elevated temperatures, forming silicates of the alkalies and alkaline earths. In the best moulding sands the potash and soda contents combined do not exceed 0.7 per cent.; (2) the Bunter sands are peculiar among moulding sands, in that the potash and soda persists even in the coarser grades of the sand, and exist as potash and soda-felspars. While the little potash occurring in the better steel moulding sands exists in the finer grades only, and then mainly as the less fusible micas (this peculiarity is a consequence of the mode of formation of the Bunter deposits, and they were formed under desert conditions where decomposition of the relatively soluble potash minerals was inhibited for want of water); and (3) an examination of the figures in the mechanical analysis reveals the cause of the low permeability figures obtained using these sands.

The most permeable sands are those with the greatest proportion of their bulk of the same grain size, and with the greatest proportion of rounded grains. It will be seen that this red sand has its bulk distributed over many sizes. The microscope reveals also that, while the coarser grains are almost perfect spheres, the finer grains are sub-angular and pack on ramming between the larger grains. This condition is illustrated by Fig. 3, wherein (*a*) represents the coarser grains, (*b*) the finer rounded grains, and (*c*) the sub-angular grains, packed by ramming.

The microscope, however, also revealed an interesting advantage possessed by these deposits. The surface of the medium and fine-sand grains is covered with a coating of ferric hydroxide; this ferruginous bond holds most tenaciously even after repeated washings with water. There is some evidence that this ferruginous

TABLE I.—*Sand Condition causing these Defects and Expressed in Physical Constants as measured on the A.F.A. Standard Sand-Testing Equipment.*

Condition.	Illustration No.	Test figures.
	FIG. 2.	
(*a*) Too dry	Dirty castings (cylinder head)	(*a*) Less than 4 per cent. moisture for actual moulding sand.
(*b*) Too weak, *i.e.*, low green strength or low dry strength.		(*b*) Less than 4 lbs. per sq. in.
(*c*) *Badly mixed sand weak or dry in patches.*		(*c*) *Sand so strong (above 10 lbs. per sq. in. green strength) that good mixing is not easily obtained.*
	FIG. 3.	
(*a*) Too weak	Broken moulds and dropped moulds	(*a*) Less than 4 lbs. per sq. in.
(*b*) *Too strong*		(*b*) *More than 10 lbs. per sq. in.*
(*c*) Too dry		(*c*) Less than 4 per cent. moisture.
(*d*) *Low "flowability"*		(*d*) *Too strong to be aerated by the disintegrator (above 10 lbs. per sq. in.)*
(*e*) High "flowability"		(*e*) So aerated or weak that the mould is completely rammed by fewer jolts than necessary with sand of normal flowability, additional jolts crack the mould.
	FIG. 4.	
(*a*) Too weak	Leaking castings due to sand inclusions (portion of bore)	(*a*) Less than 4 lbs. per sq. in.
(*b*) *Permeability low*		(*b*) *Less than* 40.
(*c*) Too dry		(*c*) Less than 4 per cent.
	FIG. 5.	
(*a*) *Permeability low*	Scabbed castings. (Cylinder head—Combustion spaces)	(*a*) *Below* 40.
(*b*) Too wet		(*b*) More than 6 per cent. for natural sands.
(*c*) Badly mixed		(*c*) *Too strong (above 10 lbs. per sq. in.) to allow of efficient mixing.*
(*a*) *Too strong giving low permeability*	Swollen castings not illustrated	(*a*) *More than 10 lbs. per sq. in. normal number of jolts does not compact the mould.*
(*b*) *And/or badly mixed*		(*b*) *More than 10 lbs. per sq. in. Too strong to allow of efficient mixing.*
	FIG. 6.	
(*a*) *Low permeability*	Blown castings (cylinder block)	(*a*) *Below* 40.
(*b*) Too wet		(*b*) More than 6 per cent.

TABLE II.—*Cylinder Crankcase. Details of Scrap Caused by Sand Defects.*

Week ending, 1933.	Jan. 6.	Jan. 13.	Jan. 20.	Jan. 27.	Feb. 1.	Feb. 8.	Feb. 15.	Feb. 22.	Mar. 1.	Mar. 8.	Mar. 15.	Mar. 22.	Mar. 29.	Apr. 5.	Apr. 12.	Apr. 19.	Apr. 26.	May 3.	May 10.	May 17.	May 24.	May 31.	June 7.	June 14.	June 21.	June 28.	July 5.	July 12.	July 19.	July 26.
Cause of scrap and number scrapped	*	*	*	*	*	*	*	*	*	*	*	*	*	*	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
Dirt	17	12	12	4	4	7	6	8	6	4	2	2	5	—	1	1	4	2	—	1	1	4	—	1	5	3	2	2	1	2
Broken moulds	5	3	4	2	4	—	1	11	1	4	—	3	6	6	5	8	5	2	8	11	19	3	—	1	2	1	5	—	1	6
Leaking	23	15	23	4	2	3	4	6	24	7	10	9	10	6	13	7	8	2	2	3	10	1	1	5	2	1	2	2	2	4
Scabbed	16	6	6	8	3	13	15	19	1	—	9	10	12	17	8	6	12	5	8	2	1	3	—	3	1	—	—	—	—	—
Swollen	3	1	1	3	2	2	5	—	12	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total scrap sand defects	64	37	46	21	15	25	31	44	44	15	21	24	33	29	27	22	29	11	18	17	31	11	1	10	10	5	9	4	4	12

Week ending, 1933 & 1934.	Aug. 2.	Aug. 9.	Aug. 16.	Aug. 23.	Aug. 30.	Sept. 6.	Sept. 13.	Sept. 20.	Sept. 27.	Oct. 4.	Oct. 11.	Oct. 18.	Oct. 25.	Nov. 1.	Nov. 8.	Nov. 15.	Nov. 22.	Nov. 29.	Dec. 6.	Dec. 13.	Dec. 20.	Dec. 27.	Jan. 3.	Jan. 10.	Jan. 17.	Jan. 24.	Jan. 31.	Feb. 7.	Feb. 14.	Feb. 21.
Cause of scrap and number scrapped	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡
Dirt	—	—	—	—	—	—	—	—	—	1	3	—	—	—	1	2	1	1	1	6	3	—	1	4	2	4	—	2	2	1
Broken moulds	4	—	1	1	8	8	2	7	1	1	5	1	2	11	1	8	8	7	6	—	—	—	1	—	—	—	—	—	—	—
Leaking	1	—	1	1	—	2	—	—	—	3	—	2	1	1	3	—	1	1	1	—	1	1	—	—	—	—	—	—	—	—
Scabbed	1	—	—	—	—	—	—	1	—	—	1	—	—	1	—	—	—	—	1	—	1	1	—	—	—	—	—	—	—	—
Swollen	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total scrap sand defects	6	—	2	2	8	10	2	8	1	5	9	3	3	13	5	10	10	9	9	6	5	2	2	4	2	4	—	2	2	1

* Red Sand Mixture was in operation up to week ending April 5. † Semi-Synthetic Sand Mixture was in operation up to week ending December 13.
‡ Synthetic Sand in operation *from* week ending December 20, 1933.

bond is burnt on to the sand grain. Ferric hydroxide mixed with similar sand grains is readily washed out, while ferric hydroxide precipitated on the sand grains and burnt on resists repeated washings.

This coating gives a grip to the clay bond and assists it in making the sand that much stronger. But what is much more interesting and important, particularly in jobbing floor work, is that this coating grips the drier bond at the mould surface, while on smooth, rounded, uncoated grains the clay bond dries, cracks and readily falls off, thus allowing the sand to frit away and expose another layer of sand to the same action (this effect is enhanced when using highly-permeable sands, which allow freer air passage and consequently more rapid drying).

It is difficult to over-stress the importance of this phenomenon. It has been the main cause of the opposition to synthetic sand by the hand moulders. The synthetic sands built up from rounded, smooth-grained sands using a water-washed deposit and a clay bond, crumbled away at the surface of the mould, particularly when the mould is open for some time, and were incapable of being patched or "sleeked."

This assumption is confirmed by the following experiments:—(*a*) The bond was taken from the red sand and transferred to a round, grained, smooth sand surface. The new sand was lower in strength than the original red sand; (*b*) a clay bond was milled with the sand grains from a washed red sand and a smooth-grained silica sand of approximately the same grain size (the red sand was again stronger; and (*c*) the bond from red sand was transferred to the sand grains of Belgian moulding sand, and the bond of Belgian was transferred to the grains of red sand (in each case the strength of the red sand was 20 per cent. higher).

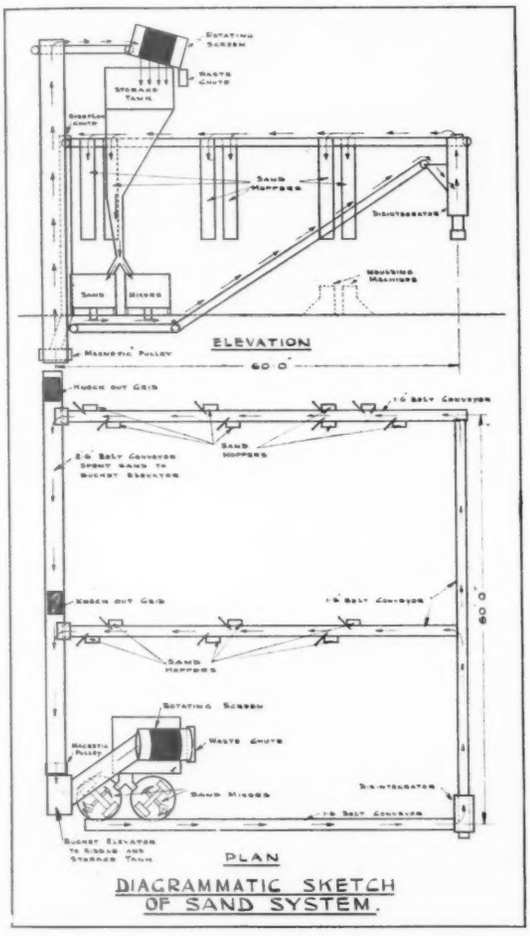

FIG. 1.

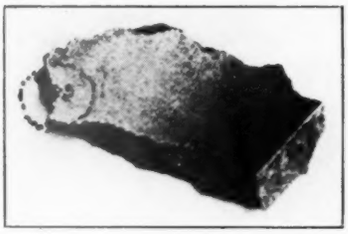

FIG. 4.—LEAKING CASTING DUE TO SAND INCLUSION. PORTION OF BORE.

FIG. 2.—DIRTY CASTING—CYLINDER HEAD.

FIG. 3.—BROKEN MOULD OR DROPPED MOULD.

Experiments (*c*) are represented by the following:—

Bond kept constant ..	Belgian grain	+ Red bond	= Strength x
	Red grain	+ Red bond	= $x + \frac{x}{5}$ strength
Bond kept constant ..	Belgian grain	+ Belgian bond	= strength y
	Red grain	+ Belgian bond	= strength $y + \frac{y}{5}$

The base grains of Belgian sand are not coated with ferric hydroxide.

At this stage the experiments narrowed the investigation of this advantage of red sand to a consideration of the surface tension between (*a*) smooth quartz and water, including smooth

quartz and water-carrying clay bond; (*b*) rough quartz and water, and water-carrying clay bond; and (*c*) quartz on which ferric hydroxide has been precipitated and burnt on as ferric oxide and water and water-carrying clay bond.

It was not found possible with the equipment available to measure these surface tensions directly and express them numerically, but it was found possible to demonstrate the difference in surface tensions between the water-carrying clay bond and sand grains representing the quartz conditions mentioned.

In an effort to demonstrate the difference between (*a*) and (*b*), silica sands from Leighton Buzzard and Erith silica sand of selected grain sizes were similarly bonded and milled, but no differences in bond strength were evident.

It was decided then artificially to roughen the silica grains, and this was most conveniently done by exposing some sand to the vapours of hydrofluoric acid. The acid-treated grains gave the higher strength figures illustrated by the following:—

	Before Treatment.	*After Treatment.*
Strength ..	12.1 lbs. per sq. in.	13.6 lbs. per sq. in.

Larger samples of sand were later treated with a dilute solution of hydrofluoric acid and etched by the vapour during evaporation.

Using the same sand but less clay bond, the increased strength was confirmed:—

Before Treatment.	*After Treatment.*
5.8 lbs. per sq. in.	6.4 lbs. per sq. in.

An increase of 10.3 per cent in strength.

These figures are the average of six determinations taken over a period of 2 hrs.

Sand on which ferric hydroxide was precipitated and burnt on as ferric oxide was compared with the same sand untreated. Erith silica sand was used. A solution of ferric chloride was added to the sand sufficient to add about 1 per cent. of Fe_2O_3 to the sand mass, a solution of ammonium hydroxide was added to precipitate the ferric hydroxide and the sand mass was then dried and heated to drive off the ammonium chloride formed and to burn on the ferric oxide.

Equal amounts of clay-bond and water were added to the treated and untreated sands, and the samples were milled for the same time. Strength and permeability figures were obtained and are as follow:—

	Untreated sand.	Treated sand (Fe_2O_3 burnt on).
Permeability ..	125	135*
Bond strength ..	5.4 and 5.7	6.0 and 6.2
35 min. later ..	5.3 ,, 5.4	6.4 ,, 6.5
60 ,, ,, ..	5.3 ,, 5.3	6.5 ,, 6.5
110 ,, ,, ..	5.5 ,, 5.5	6.7 ,, 6.7
19 hrs. later ..	7.4	8.0
Average of 8 determinations ..	5.4	6.4

An increase of 18.5 per cent. in strength.

* The difference in permeability is due to this sand being stronger and not as easily compacted by ramming as the untreated sand, possibly also to the fact that the bond on the treated sand was in the state of thin pellicles continuously enveloping each of the oxide-covered sand grains, while the bond on the untreated sand due to the lower surface energy was not as evenly distributed.

The strength increases are marked and are obviously a function of the surface tensions between the water-carrying clay bond and the quartz conditions represented by the conditions of the sand grains used.

Apart from the strength increases enumerated, other interesting manifestations of increased surface tension were evident during the experiments. On the nickel-plated wheels of the laboratory mixer used, the sands with the lower surface tension between bond and grains adhered to the polished surface. The sands with the higher surface tension did not adhere to the wheels. This adds another advantage of this type of sand when working with metal patterns.

(*To be concluded.*)

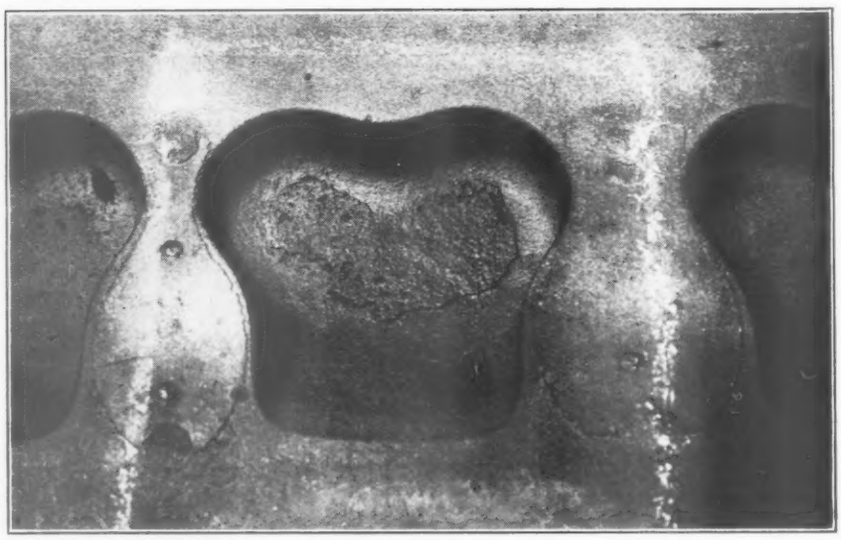

FIG. 5. SCABBED CASTINGS. CYLINDER-HEAD COMBUSTION SPACES.

FIG. 6.—BLOWN CASTING. CYLINDER BLOCK.

FIG. 7.—SHOWS CONDITION OF UNBROKEN CLAY PELLETS FUSED IN THE SAND MASS.

Studies on Cast Red Brass for the Establishment of a Basic Classification of Non-Ferrous Ingot Metals for Specification Purposes

By C. M. Saeger, Junr.

[AMERICAN EXCHANGE PAPER.]

(*Concluded from page 370.*)

Metallographic structure.—In an endeavour to explain the reason for the pronounced influence of the pouring temperature on the physical properties of sand-cast bars and specimens obtained by the immersed-crucible method, the macro-structure of bars cast at 1,205 and 1,260 deg. C. was studied. Photographs of etched medial longitudinal section perpendicular to the parting line of the mould are shown in Figs. 12 and 13. The tendency for the formation of a columnar crystalline structure in the bars cast at the higher temperatures was much more pronounced than in the corresponding bars poured at the lower temperatures. A comparison of these results with those previously given indicates that a marked columnar structure is accompanied by inferior physical properties.

Very little difference in structure was found in the two types of sand-cast bars that were cast to size; in both, the columnar structure predominated. In the larger specimens of this type, machined to size, the difference in structure caused by the pouring temperatures was more pronounced. In all of the fin-gate sand-cast bars, a marked non-uniformity of structure across the section of the bar existed. The portion of the bar formed in the "drag" of the mould had a pronounced columnar structure, whereas the remainder, which was undoubtedly influenced by the relatively large mass of metal in the attached riser, had an equiaxed crystalline structure. Such a marked non-uniformity of structure across the section of a test-bar is not desirable and should be avoided.

The observed difference in physical properties of bars obtained by the immersed-crucible method at 1,205 and 1,260 deg. C. is believed to be due largely to the difference in grain-size.

The effect of pouring temperature on the microstructure of the various test-bars is shown in Figs. 14 and 15. In each case the micrograph shows a representative area in the reduced section of the bar just within the inner surface layer of the columnar crystals. Within the individual grains of all the sand-cast specimens were found markings consisting of groups of parallel lines which were considered to be the result of deformation or strain during cooling. This structural feature was not found in the bars obtained by the immersed-crucible method. This fact indicates that no strains are set up in the latter bars on cooling, such as exist in the sand-cast bars when the gates and risers are in a fixed position within the sand mould. These apparently cause permanent straining of the bar by shrinkage during cooling, while the metal is in a very "tender" condition immediately after solidification.

Effects of Small Percentages of Sulphur or Iron

The second phase of the investigation was the effect of specific amounts of impurities on the physical properties of the alloy. In this part of the study a reduction was made in the number

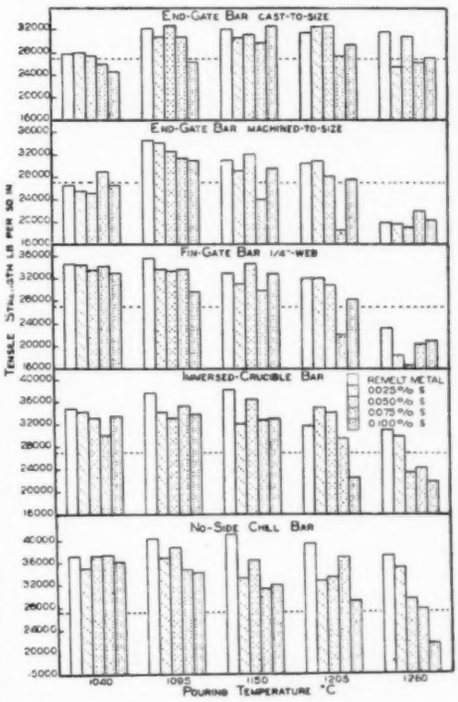

FIG. 16.—EFFECT OF POURING TEMPERATURES UPON THE TENSILE STRENGTH OF RED BRASS CONTAINING SULPHUR.

The minimum tensile strength for this alloy (A.S.T.M. Designation B 30-32T) is indicated by the broken line.

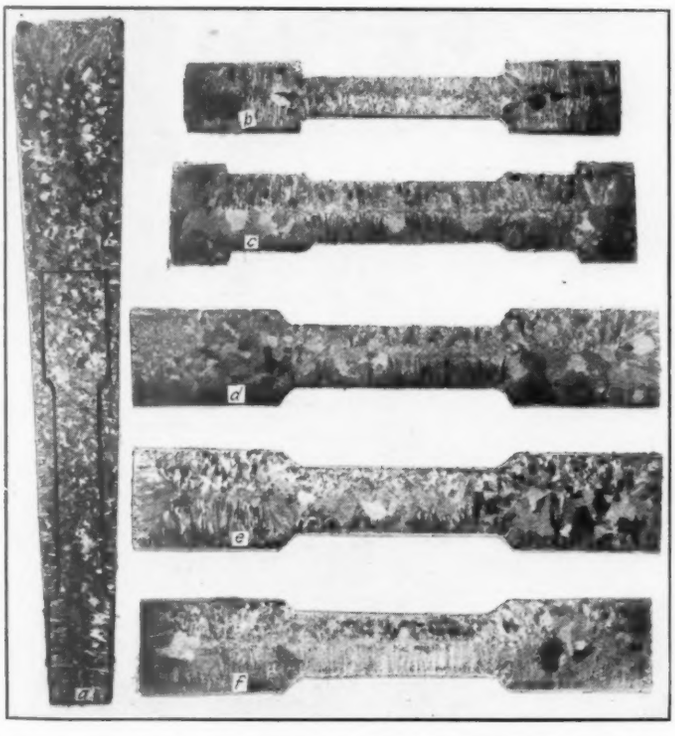

FIG. 12.—MEDIAL LONGITUDINAL SECTION OF TEST-BARS OF VIRGIN METAL, CAST AT 1,205 DEG. C., THE SECTION BEING PERPENDICULAR TO THE PARTING FACE OF THE SAND MOULD.

Etched with ammoniacal solution of copper-ammonium chloride; reduced one-half in reproduction.

(*a*) Ingot obtained by immersed-crucible method. (*b*) End-gate sand-cast bar, cast-to-size.
(*c*) End-gate sand-cast bar, machined-to-size. (*d*) Fin-gate bar, $\frac{1}{8}$-in. web.
(*e*) Fin-gate bar, $\frac{3}{16}$-in. web. (*f*) Fin-gate bar, $\frac{1}{4}$-in. web.

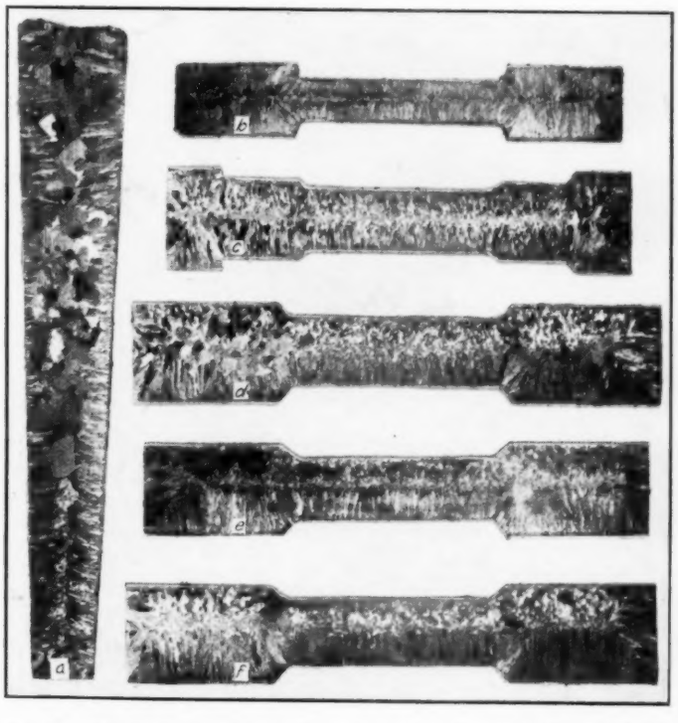

FIG. 13.—MEDIAL LONGITUDINAL SECTION OF TEST-BARS OF VIRGIN METAL, CAST AT 1,260 DEG. C., THE SECTION BEING PERPENDICULAR TO THE PARTING FACE OF THE SAND MOULD.

Etched with ammoniacal solution of copper-ammonium chloride; reduced one-half in reproduction.

(*a*) Ingot obtained by immersed-crucible method. (*b*) End-gate sand-cast bar, cast-to-size.
(*c*) End-gate sand-cast bar, machined-to-size. (*d*) Fin-gate sand-cast bar, $\frac{1}{8}$-in. web.
(*e*) Fin-gate sand-cast bar, $\frac{3}{16}$-in. web. (*f*) Fin-gate sand-cast bar, $\frac{1}{4}$-in. web.

XUM

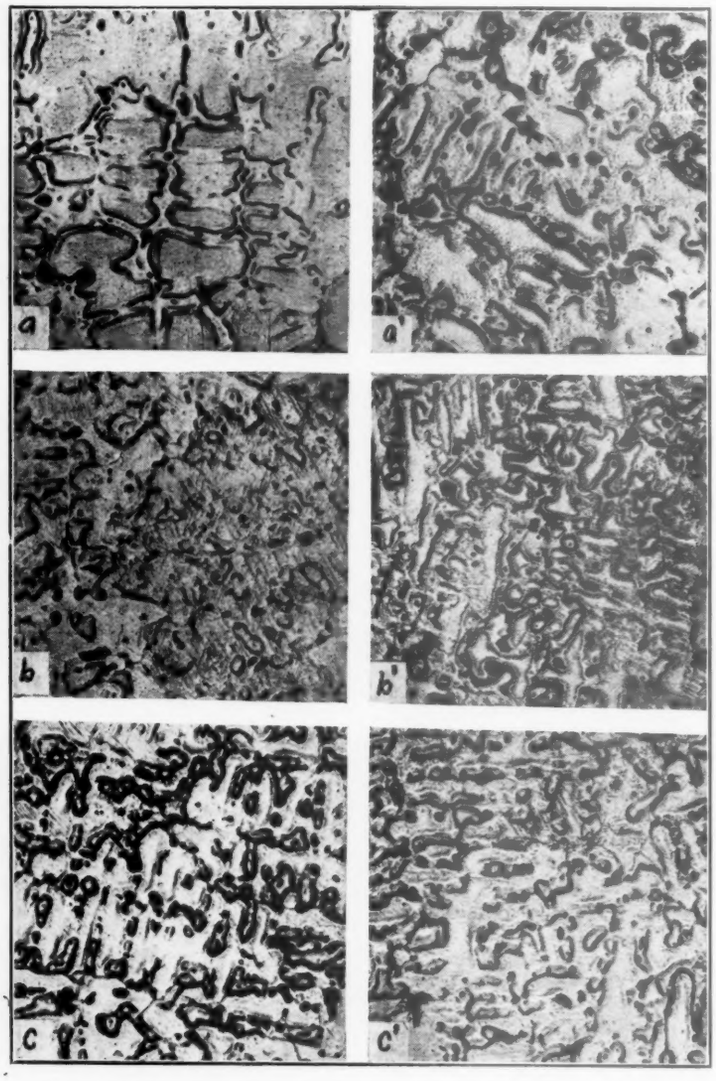

FIG. 14.—MICROSTRUCTURE OF TEST-BARS OF VIRGIN METAL. (× 100.)

Etching reagent, mixture of ammonium hydroxide and hydrogen peroxide.

(*a*) Ingot obtained by immersed-crucible method at 1,205 deg. C. (*a'*) Ingot obtained by immersed-crucible method at 1,260 deg. C. (*b*) End-gate sand-cast bar, cast-to-size, poured at 1,205 deg. C. (*b'*) End-gate sand-cast bar, cast-to-size, poured to 1,260 deg. C. (*c*) End-gate sand-cast bar, machined-to-size, poured at 1,205 deg. C. (*c'*) End-gate sand-cast bar, machined-to-size, poured at 1,260 deg. C.

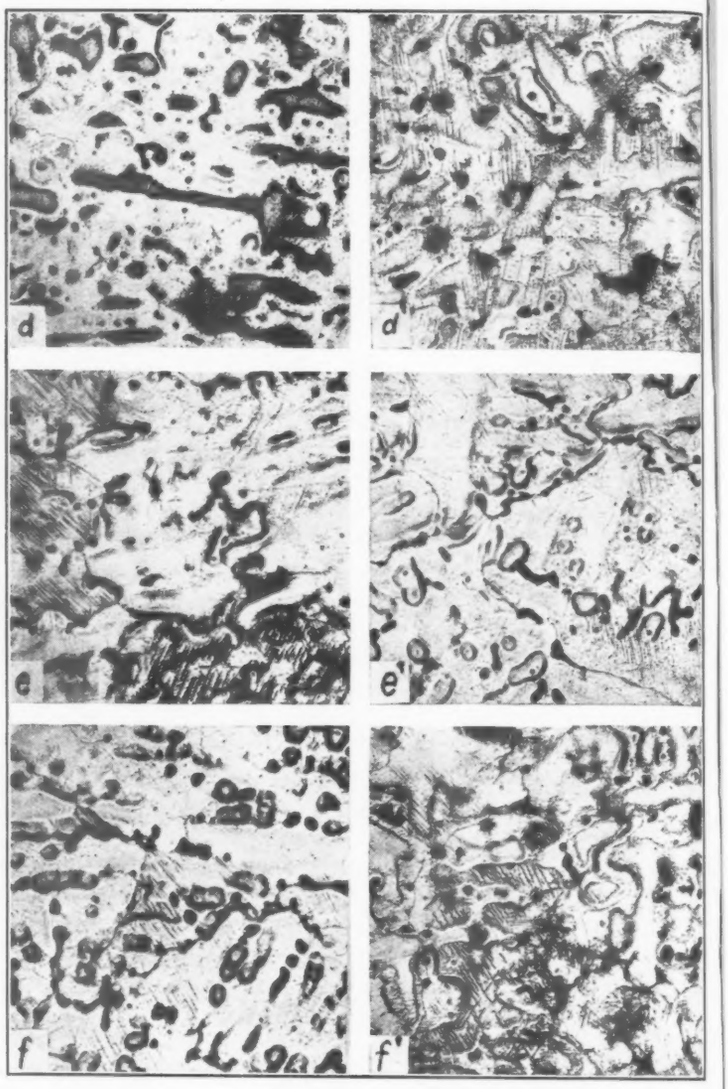

FIG. 15.—MICROSTRUCTURE OF TEST-BARS OF VIRGIN METAL. (× 100.)

Etching reagent, mixture of ammonium hydroxide and hydrogen peroxide.

(*d*) Fin-gate sand-cast bar, ¼-in. web, poured at 1,205 deg. C. (*d'*) Fin-gate sand-cast bar, ¼-in. web, poured at 1,260 deg. C. (*e*) Fin-gate sand-cast bar, $\frac{3}{16}$-in. web, poured at 1,205 deg. C. (*e'*) Fin-gate sand-cast bar, $\frac{3}{16}$-in. web, poured at 1,260 deg. C. (*f*) Fin-gate sand-cast bar, ⅛-in. web, poured at 1,205 deg. C. (*f'*) Fin-gate sand-cast bar, ⅛-in. web, poured at 1,260 deg. C.

of types of test-bars. Those used were the immersed-crucible bar, the end-gate bar, both "cast to size" and "machined to size," the fin-gate bar with ¼-in. web, and the "no side chill" bar from the cast ingot. These bars were cast from heats of remelted metal to which had been added from 0.025 to 0.10 per cent. of sulphur or 0.10 to 0.60 per cent. of iron. The effects of sulphur and iron on the physical properties were determined by comparison with those of remelted metal. The values for remelted metal at pouring temperatures of 1,065 and 1,230 deg. C. were obtained by averaging the values previously given for 1,040 and 1,095 deg. C. and for 1,205 and 1,260 deg. C., respectively.

Tensile strength.—The results in Fig. 16 indicate a slight decrease in tensile strength as the sulphur content was increased. Comparison of the values for the four types of bars with reference to "the minimum tensile strength expected for this alloy,"[9] indicated by the broken line in Figs. 16 and 17, shows that most of the bars which had tensile strengths much below this "minimum" were cast at 1,205 and 1,260 deg. C. From these results it appears that the pouring temperature had more influence on the tensile strength than had the sulphur content.

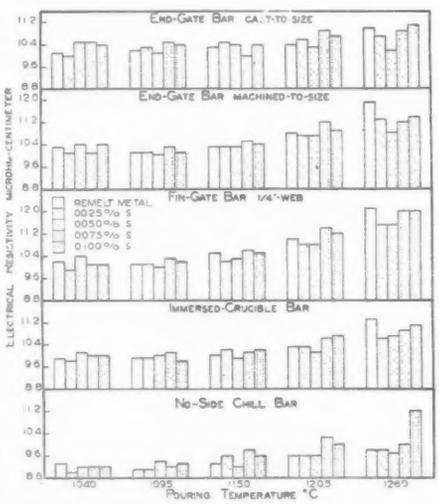

FIG. 20.—EFFECT OF POURING TEMPERATURE UPON THE ELECTRICAL RESISTIVITY OF RED BRASS CONTAINING SULPHUR.

The results in Fig. 17 indicate that the addition of iron tended to increase the tensile strength, especially of the sand-cast bars. This effect may be caused by the iron acting as a deoxidiser. Hanson and Ford,[9] in their investigation on the effect of impurities in copper, found that in an oxidising atmosphere iron acts as a deoxidiser for copper. Dews[10] has reported that this same reaction occurs in bronzes.

Brinell hardness.—The results of the Brinell hardness determinations are shown in Figs. 18 and 19. In the American Society for Testing Materials specification for this alloy[11] a Brinell hardness number of 50 to 60 is required. In Figs. 18 and 19 the minimum value of 50 is indicated by a broken line. In the curves showing the effects of sulphur, it may be noted that many of the bars containing sulphur and poured at 1,205 or 1,260 deg. C. have hardness numbers below 50.

The addition of iron appeared to raise the Brinell hardness, and the values were well above the required minimum value of 50, with the exception of some of the sand-cast bars poured at 1,230 deg. C.

Electrical Resistivity.—The data in Figs. 20 and 21 show that sulphur has little effect on the resistivity of the test-bars poured at or

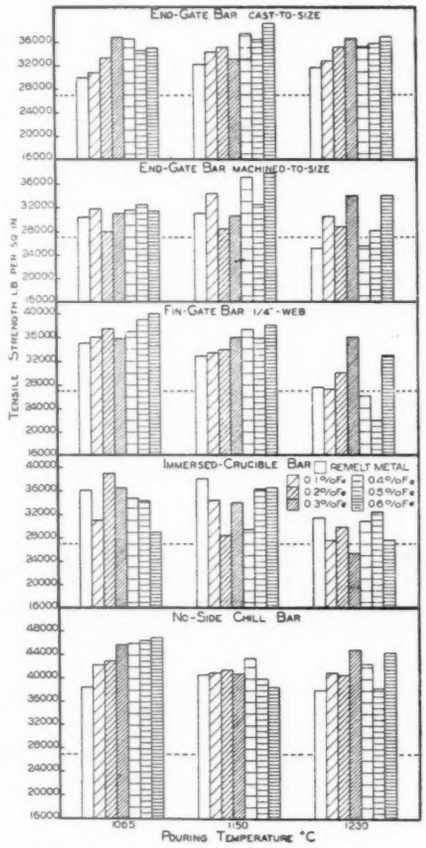

FIG. 17.—EFFECT OF POURING TEMPERATURE UPON THE TENSILE STRENGTH OF RED BRASS CONTAINING IRON.

The minimum tensile strength for this alloy (A.S.T.M. Designation B 30-32T) is indicated by the broken line.

Studies on Cast Red Brass for the Establishment of a Basic Classification of Non-Ferrous Ingot Metals for Specification Purposes

Figs. 17, 18, 19, 21, 22, 23

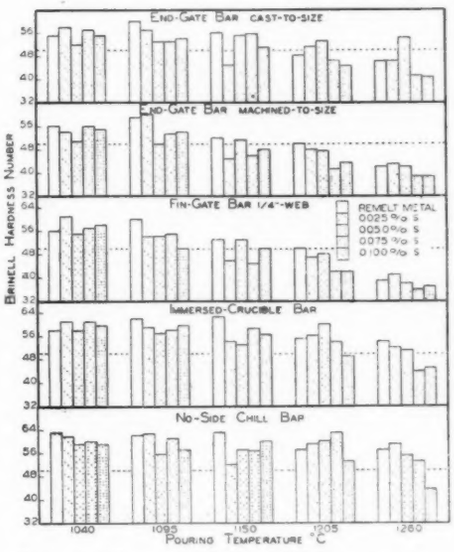

FIG. 18.—EFFECT OF POURING TEMPERATURE UPON THE BRINELL HARDNESS OF RED BRASS CONTAINING SULPHUR.

The minimum Brinell hardness for this alloy (A.S.T.M. Designation B 30-32T) is indicated by the broken line.

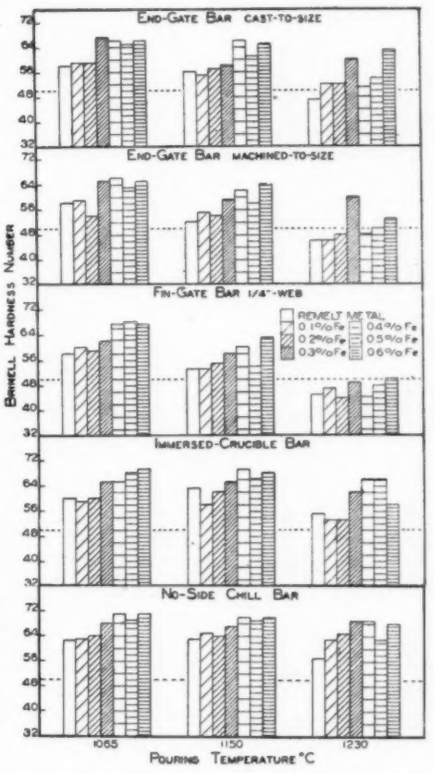

FIG. 19.—EFFECT OF POURING TEMPERATURE UPON THE BRINELL HARDNESS OF RED BRASS CONTAINING IRON.

The minimum Brinell hardness for this alloy (A.S.T.M. Designation B 30-32T) is indicated by the broken.

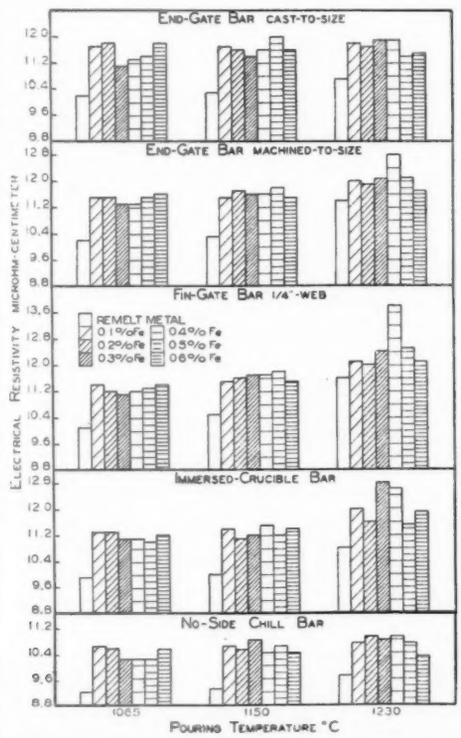

FIG. 21.—EFFECT OF POURING TEMPERATURE UPON THE ELECTRICAL RESISTIVITY OF RED BRASS CONTAINING IRON.

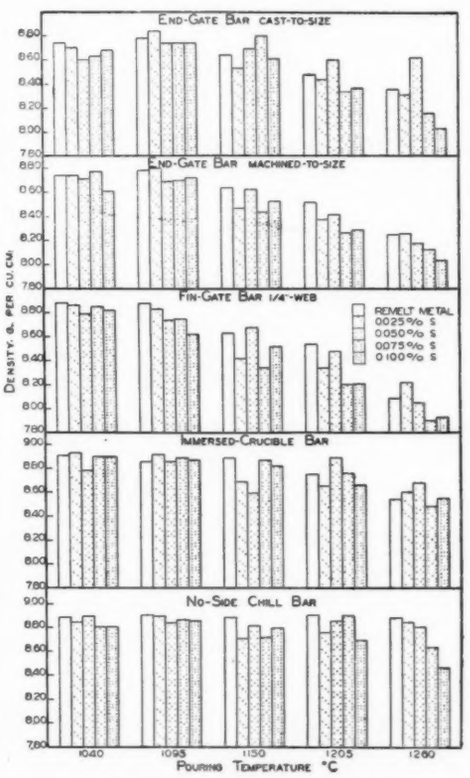

FIG. 22.—EFFECT OF POURING TEMPERATURE UPON THE DENSITY OF RED BRASS CONTAINING SULPHUR.

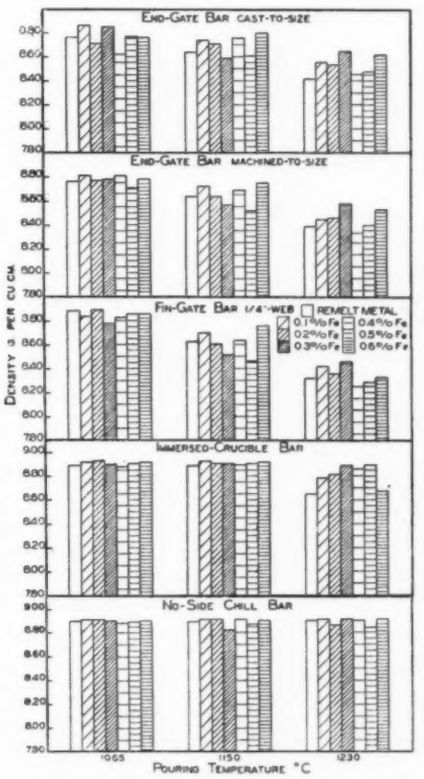

FIG. 23.—EFFECT OF POURING TEMPERATURE UPON THE DENSITY OF RED BRASS CONTAINING IRON.

below 1,150 deg. C. Higher resistivities were obtained, however, on the bars poured at 1,205 and 1,260 deg. C. This increase in resistivity is apparently caused by the increase in the pouring temperatures rather than by the increase in the sulphur content.

A marked increase in electrical resistivity was found for all test-bars containing 0.1 per cent. iron, but no significant further increase was found for iron contents up to 0.6 per cent.

Density.—The data in Figs. 22 and 23 show that the density of this alloy was affected to a greater extent by the pouring temperature than by changes in the content of sulphur or iron.

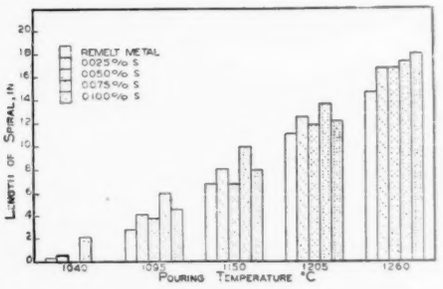

FIG. 24.—EFFECT OF POURING TEMPERATURE UPON THE RUNNING PROPERTIES OF RED BRASS CONTAINING SULPHUR.

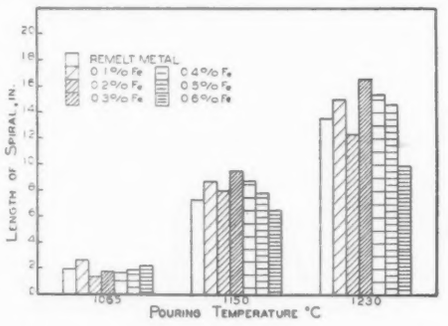

FIG. 25.—EFFECT OF POURING TEMPERATURE UPON THE RUNNING PROPERTIES OF RED BRASS CONTAINING IRON.

Running Properties.—The data in Figs. 24 and 25 show that sulphur somewhat increased the running quality of the alloy at all pouring temperatures, and especially at the higher temperatures. The alloy poured at the higher temperatures (1,150 and 1,230 deg. C.) showed slightly increased running properties, with an increase in iron content up to 0.3 per cent., but above this iron content the running properties decreased.

Shrinkage.—The data in Figs. 26 and 27 show that there was an increase in the specific volume with increase of sulphur content at all pouring temperatures. The effect of iron on the specific volume was not so definite or so uniform as that of sulphur. The shrinkage of the alloy in the solid state was not influenced to any significant extent by the additions of either sulphur of iron.

Neither sulphur nor iron appreciably influenced either the *solidus* or the *liquidus* temperature of this alloy. Although the sulphur or iron produced a slight change in the specific volume of the liquid and solid metal, the slopes

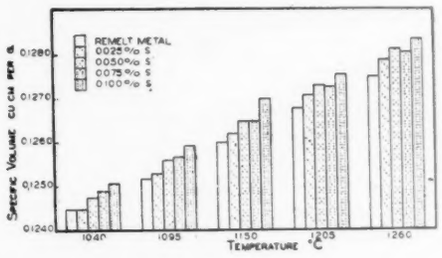

FIG. 26.—EFFECT OF TEMPERATURE UPON THE SPECIFIC VOLUME OF RED BRASS CONTAINING SULPHUR.

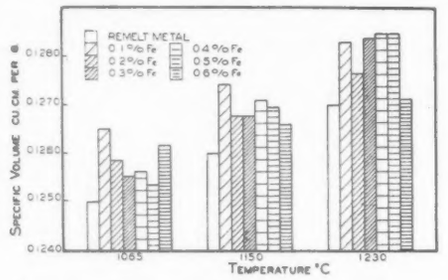

FIG. 27.—EFFECT OF TEMPERATURE UPON THE SPECIFIC VOLUME OF RED BRASS CONTAINING IRON.

of the specific volume-temperature curves are the same as those reported for virgin and remelted metal. Hence, there was no significant change in the shrinkage.

It is evident from these data that sulphur or iron in the amounts used are not necessarily injurious to the alloy 85-5-5-5 if the pouring temperature is kept below 1,205 deg. C.

SUMMARY

The tensile strength, electrical resistivity, hardness and density of cast red brass (Cu, 85; Sn, 5; Zn, 5; Pb, 5) were determined on four types of test-bars—two sand-cast, a chill ingot and a special bar dipped from the molten metal. The pouring temperature was varied from 1,040 to 1,260 C. Data on the shrinkage and running properties were also obtained. The most important results are as follow:—

(1) The properties of test-bars made of virgin or of remelted metal of the same nominal composition, cast at the same temperature, were alike.

(2) The pouring temperature affected the properties of all the test-bars much more than any other factor. In general, the best results for the sand-cast bars were obtained with a pouring temperature below 1,205 deg. C.

(3) These effects of pouring temperature on the physical properties of test-bars were the same for alloys containing either sulphur (maximum 0.10 per cent.) or iron (maximum 0.6 per cent.).

(4) The physical properties of test-bars poured at 1,150 deg. C. or below were not appreciably affected by the presence of sulphur up to 0.10 per cent. In bars poured at higher temperatures 0.10 per cent. of sulphur adversely affected the properties, particularly of the sand-cast bars. Additions of iron up to 0.6 per cent. had similar but much less pronounced effects.

(5) The detrimental effects of high pouring temperatures and of impurities were much more pronounced in the sand-cast bars than in the other types. The non-uniform grain structure of the sand-cast bars and the existence in them of a strained condition during cooling are probably related to these effects.

(6) The flowing properties increased with the pouring temperature. The presence of sulphur, up to 0.10 per cent., improved the flowing properties, while iron had no consistent influence. Similar statements apply to the shrinkage.

(7) A comparison of the results for tensile strength and hardness with the minimum requirements for this alloy in ingot form set forth by the American Society for Testing Materials shows (*a*) that the end-gate sand-cast bar is unsuitable for low pouring temperatures; (*b*) that, with this exception, all sand-cast bars of virgin or remelted metal poured at a temperature not exceeding 1,205 deg. C. easily meet these minimum requirements; and (*c*) the presence of sulphur up to 0.10 per cent., or of iron up to 0.6 per cent., is not objectionable in sand-cast bars. The adverse effect of pouring temperatures above 1,205 deg. C. was not so pronounced in the chilled-ingot and other bars as in the sand-cast bars.

(8) The relatively wide variation in the physical properties of different types of test-bars obtained from the same heat of metal forcibly emphasises the need for a standard method for obtaining the test-bars. In many respects the sand-cast bars were not so suitable as those obtained by other methods.

REFERENCES.

8 Appendix to Tentative Specifications for Copper-Base Alloys in Ingot Form for Sand Castings (A.S.T.M. Designation: B30-32T), "Proceedings, Am. Soc. Test. Mats.," Vol. 32, Part I, p. 677, 1932; also A.S.T.M. Tentative Standards, p. 237, 1932.

9 D. Hanson and G. W. Ford, "Investigation of the Effects of Impurities on Copper," Part II. The Effect of Iron on Copper, "Jour. Inst. of Metals, Vol. 32, p. 335, 1924.

10 H. C. Dews, "The Metallurgy of Bronze." Sir Isaac Pitman & Sons, Lond., 1930.

11 Appendix to Tentative Specifications for Copper-Base Alloys in Ingot Form for Sand Castings (A.S.T.M. Designation: B30-32T). "Proceedings, Am. Soc. Test. Mats.," Vol. 32, Part I, p. 677, 1932. Also "1932 Book of A.S.T.M. Tentative Standards," p. 237

Speedomax Radiation Pyrometer

The Speedomax radiation pyrometer consists of two elements, the Speedomax recorder and L. & N. radiation thermotube. Each is a recent development of the research and engineering staffs of Leeds & Northrup Company, who are represented in this country by the Integra Company, Limited, Birmingham. The Speedomax recorder is said to be ten times as fast as the usual industrial potentiometer. It operates on the well-known potentiometer principle, but the usual galvanometer and mechanical balancing mechanisms are replaced by an electrical system which makes the instrument extremely rapid. In securing this responsiveness, accuracy has not been sacrificed, and the instrument is rugged, so that its balancing is unaffected by ordinary vibrations. The recorder requires a 115-volt, 60-cycle power supply. The L. & N. radiation thermotube has characteristics which adapt it for use with the Speedomax recorder to constitute a radiation pyrometer admirably suited to record temperatures accurately and to follow changes rapidly. The tube responds very quickly to variations in energy radiated. Two seconds after a hot billet comes into line of sight, its temperature has been recorded. Any change in temperature along the billet itself is then recorded in a fraction of a second.

A rapid-temperature recorder of this nature has numerous applications. Temperatures can now be recorded automatically as slabs and sheets, for instance, move along the roll mill, between stands, or after the final pass. The instrument is amply fast to record the temperature drop due to water spraying on the hot steel during a temporary pause when roll-table speed is not synchronised with roll speed. It will also show when one part of a slab is hotter than another due to improper operation of the reheating furnace. Standard ranges of temperature are from 1,000 to 2,200 deg. Fah. and 1,300 to 3,000 deg. Fah., while special ranges up to 5,000 deg. Fah. can be furnished.

Copper Harder than Steel

Copper harder than structural steel has been produced at the Montana School of Mines by a comparatively simple heat-treatment. For a number of years it has been known that the addition of small portions of nickel and silicon to copper produced an alloy which would respond to heat-treatment. An alloy of this type has now been made at Montana with a tensile strength of about 45 tons per sq. in. and a hardness considerably more than that of structural steel.

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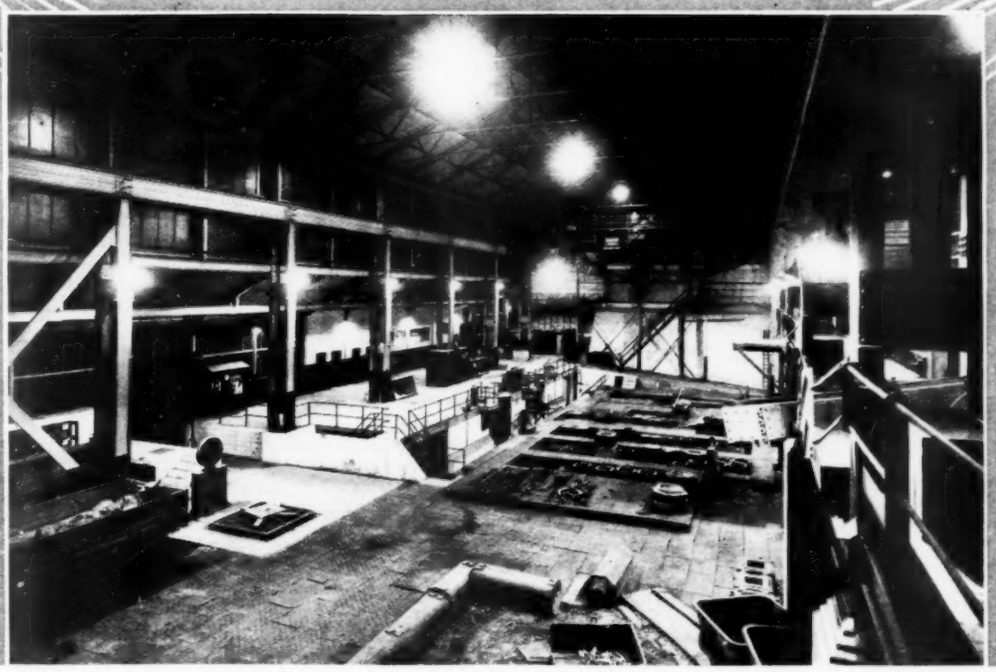

A casting bay at Messrs. Samuel Fox & Co's. Steel Works, Stocksbridge, Near Sheffield. Main illumination by "OSIRA" Lamps.

INTERIOR LIGHTING

For many industrial processes, particularly those associated with the handling and inspection of metals, the bluish-white colour of the light from the "OSIRA" Lamp has proved far superior to that of the ordinary incandescent Electric Lamp apart from the increased efficiency. The "OSIRA" Lamp gives 2½ times as much light as a Tungsten filament lamp using the same amount of current, and with appropriate G.E.C. Fittings, a remarkably high and even standard of illumination is assured.

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Eleventh International Acetylene Congress, Rome, June, 1934

FROM OUR OWN CORRESPONDENT

This Congress—the first held since 1930—ended on June 10. It was attended by over 700 delegates from all parts of the world, including a British contingent comprising the President of the British Acetylene Association (Major C. P. N. Raikes, M.C.), Dr. Watts, of the Home Office, Mr. K. S. Murray, Mr. P. B. Liversedge, Mr. A. Hoddle (Past-Presidents of the B.A.A.), Mr. Victor Amodeo, Mr. L. J. Tibbenham and Mr. A. B. Harrower. Over one hundred Papers had been submitted, and many of these were upon highly technical matters relative to the chemistry of acetylene and to metallurgical matters of theoretical rather than immediate practical interest to those engaged in industries in which oxy-acetylene welding is used.

Welding Cast Iron

Whilst the welding of cast-iron and of non-ferrous castings is mentioned in a number of the Papers, three stand out as the most important contributions on this subject. Mr. A. Baillon, for instance, in a Paper entitled "Suppression des grains gros et des soufflures dans la soudure des pièces de fonte," points out that castings repaired by oxy-acetylene welding often require total or partial machining by turning, boring, shaping, etc., and that in nearly all cast-iron welds hard metal is encountered which delays the work by blunting the tools used, thus rendering the machining or similar operation long and difficult, and sometimes impossible. This hard metal is always accompanied by blowholes. M. Baillon enumerates the various theories which have hitherto been put forward by metallurgists as to the causes of these phenomena in cast-iron welds. Some, he says, attribute the formation of hard metal to the introduction, when the metal is in a liquid condition, of a portion of iron oxide which is reduced and carburised and thus forms a hard grain. Others blame the presence of particles of sand in the welding rod; loss of carbon or silicon at the point of fusion; too speedy cooling, etc. In order, therefore, to avoid trouble, the usual recommendations made are to prevent, in welding, the tip of the blowpipe from coming into contact with the cast metal; to use a powerful blowpipe with an excess of acetylene in the flame; to use welding rods containing more than the usual quantity of silicon, and to allow the welded castings to cool very slowly in the air.

Whilst the author is in agreement as to the importance of these precautions in cast-iron welding, his researches have brought him to the conclusion that in many instances both the hard metal or "hard spot" and the blowholes are caused by the use of powders or fluxes obtained from alkaline salts. He has found, he states, that the alkaline carbonates of sodium, potassium, etc., and salts of alkaline earth metals react on the silicon which has been incorporated in the cast iron to keep it in the graphitic condition. The carbonates combine with the silicon and oxide of iron to form a double silicate of iron and alkaline metal, forming carbonic-acid gas, which accounts for the presence of blowholes in the immediate vicinity of the hard spot. In order to obtain homogeneous welds on cast iron free from hard spots and blowholes, M. Baillon advocates the elimination of the use of fluxes containing alkaline and earth-alkaline carbonates which are unstable at high temperatures.

Bronze Welding

A Paper of practical utility was presented by Mr. A. B. Kinzel and Mr. A. R. Lytle, of U.S.A., on bronze welding. After describing the essentials of the bronze-welding process, and in the course of their description emphasising the importance of accurate preparation of the rods to be used, the authors discuss the composition of various types of bronze-welding rod. They point out that the addition of silicon to the average bronze-welding rod composition "represents one of the greatest advances in the bronze-welding rod development. Due to the presence of this alloying element the flowing qualities and physical properties of the metal are so improved that the silicon-containing rods may be considered to be a distinctive type of bronze-welding rod. Silicon is of value in three ways: first, silicon-containing bronze-weld metals are sound, while bronze-weld metals that do not contain silicon are characterised by porosity. This difference seems to be due to the ability of silicon to cause gases that are dissolved in the molten metal to be retained in solution during the solidification process. Second, silicon is a powerful deoxidiser . . . Third, in silicon-containing bronze-weld metal, the evaporation and subsequent oxidation of zinc are considerably retarded due to the presence of the silica coating on the molten surface."

Bronze Welding of Cast-Iron Pipes

Dealing with the bronze welding of cast-iron pipes, the authors say: "For this use a special shear V-type of joint has been developed that takes advantage of the higher shear strength of bronze on cast iron. With this type of joint the full strength of the pipes, as determined by this transverse test, can be readily and consistently obtained. In this operation also, the value of the silicon-containing rods is further demonstrated. In comparable tests, welds made with the copper-zinc-tin rod failed in the transverse bend test at 90 per cent. of the strength of the unwelded pipe, while joints welded with silicon-containing rod failed at a stress substantially equal to the strength of unwelded pipes. The type of fracture indicated that the porosity in the silicon-free rod had led to premature failure."

A further note in connection with bronze welding of cast-iron pipes is worthy of quotation at length: "After cast-iron pipes have been machined for bronze welding it is frequently difficult to obtain proper union between the bronze and cast iron. Investigation disclosed that this difficulty was due to the presence of graphite, smeared on the surface of the cast iron during the machining operation. The removal of this graphite is now accomplished by a heating or oxidising treatment, in which the end of the cast-iron pipe, after machining, is heated to about 900 deg. C., at which temperature scaling of the machined surface occurs. After the pipe is cool the bronze weld metal will flow quite readily on to the scaled surface." The authors also recommend a slightly excess oxygen flame for bronze welding as better than the strictly neutral flame, whilst any excess acetylene should be carefully avoided.

A Paper on the "Welding Rods for Cast Iron" was read by Mr. L. J. Tibbenham, and we propose to make an extended abstract of this in a future issue.

During the course of the Congress arrangements were made for several excursions to places of beauty and historical interest in the neighbourhood of Rome, as well as for an audience with His Holiness the Pope (who addressed the delegates in a very knowledgeable speech from his throne) and a reception by H.E. the Governor of Rome. Thus it was that rather too little time was available for adequate discussion of the Papers presented. As a whole, however, the organisation of the Italian authorities was admirable, and no more inspiring or eloquent leader could have been found than Senator Tofani, the President, or more hard-working general secretary than Signor Tomassi.

MR. J. E. HURST, Senior Vice-President of the Institute of British Foundrymen, has been appointed to the directorate of Messrs. Bradley & Foster, Limited, of Darlaston.

Annual Conference

(*Concluded from page* 390.)

work as they had been able to do for the Conference had been a real pleasure, and the Conference would always be a very happy memory.

MR. R. A. MILES proposed a vote of thanks to Mrs. Stubbs for the work which she had done as chairman of the Ladies' Committee, and to all connected with the organisation of the Conference. Mrs. Hogg seconded the vote of thanks, and remarked upon the interest Mrs. Stubbs had always shown in the work of the Lancashire Branch, and also of the Burnley Section of the Branch.

In responding to the vote of thanks, MRS. STUBBS paid a special tribute to the assistance and co-operation that she had received from Mrs. J. E. Cooke, secretary of the Ladies' Committee.

Whole-Day Excursion to Llangollen

Friday, June 8, was devoted to a whole-day excursion. The party left Manchester by motor-coach, and travelled by way of Northwich, Tarporley and Whitchurch, to Llangollen in North Wales, luncheon being served at the Hand Hotel.

After luncheon, the party made their way to the boat landings on the canal, and proceeded to the source of the canal at Berwyn, a distance of about two miles, in horse-drawn barges. The canal at Llangollen is certainly an artificial waterway, but bears no resemblance to the type of waterway that one usually visualises as a canal. It is cut out of the hillside, is lined with trees, and commands most entrancing views of the Valley of the Dee. After leaving the barges, a short walk brought the party to an artificial waterfall, known as the Horse Shoe Falls, which is situated in one of the most beautiful parts of the Dee Valley. The coach journey was resumed at this point, and gradually climbed up the Horse Shoe Pass, the summit of which is about 1,100 ft. above sea level, then commenced the long gradual descent over the moors to the city of Chester. On arrival at Chester, tea was served at Bolland's Café.

MR. C. E. WILLIAMS, Ex-President, said that, as the immediate Past-President of the Institute, he probably had a clearer recollection than the other Past-Presidents of the work involved in the preparation of a large conference, and on behalf of the visitors he wished to tender to the Conference Committee and to the Lancashire Branch the sincere thanks for all they had done in organising the Conference, and hearty congratulations upon the success of their work.

The Lancashire Branch as a whole, and their ladies, had co-operated in an admirable manner. He felt, however, that special thanks were due to the President, Mr. Roy Stubbs, to the President of the Lancashire Branch, Mr. W. N. Cook, to the secretary of the Lancashire Branch, Mr. J. E. Cooke, and to his wife and daughter. He also acknowledged the valuable work which had been done by Mr. Makemson, the general secretary, and by Miss Crook and Miss Walmsley of the general office.

The vote of thanks was carried enthusiastically with loud applause, and Mr. W. N. Cook responded on behalf of the Lancashire Branch.

After tea a short time was spent in exploring the ancient city of Chester, and the party then returned to Manchester.

Merchandise Marks Act, 1926—Chain Blocks

The Board of Trade announce that, in pursuance of Section 7 of the Merchandise Marks Act, 1926, a draft Order in Council was laid before Parliament on May 30, 1934, requiring imported chain blocks of metal to bear an indication of origin on sale or exposure for sale in the United Kingdom. The draft Order has been published and copies may be purchased from His Majesty's Stationery Office, either directly or through any bookseller.

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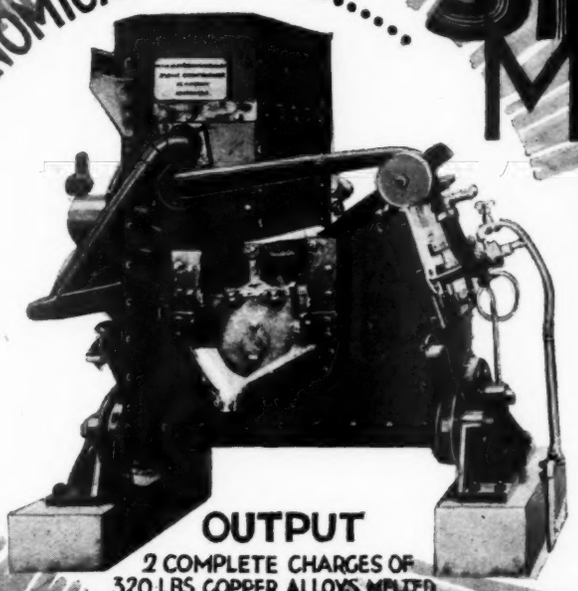

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This Week's News in Brief

Trade Talk

ANOTHER FURNACE has been kindled at the billet plant of the Clydesdale Steel Works, Bellshill. The works are busy, and the additional furnace is to cope with increased orders.

CREWE IS TO BE THE CENTRE for the manufacture of steel castings and for all forge work for the L.M.S. system. This decision will mean the transfer to Crewe of men working on these processes at Glasgow, Norwich and Derby

THE FALKIRK IRON COMPANY, LIMITED, a constituent firm of Allied Ironfounders, Limited, has secured an order for the manufacture and supply of the new plant, etc., in the main kitchen of the Eastern Hospital at Homerton for the London County Council.

A HALF-YEARLY CONTRIBUTION of £135 to infirmaries and charitable institutions in the West of Scotland has been made by the employees of Messrs. Babcock & Wilcox, Limited, Renfrew, and of £152 by the employees of Messrs. Barr & Stroud, Limited, Anniesland, Glasgow.

THE BRITISH IRONFOUNDERS' ASSOCIATION and associated organisations have changed their address from 100, Wellington Street, Glasgow, to 145, St. Vincent Street, Glasgow, C.2. The telephone number and telegraphic address are unchanged at Glasgow Central 4950 and "Groundwork, Glasgow."

MESSRS. MIRRLEES, WATSON COMPANY, LIMITED, Scotland Street, Glasgow, have secured a contract for the sugar machinery required to replace a sugar factory built in Jamaica more than half a century ago, in order to permit normal progress in modernisation of the industry of the island. The value of the contract is £70,000

THE HAMMOND LANE FOUNDRY COMPANY, LIMITED, Dublin, has opened a new factory for the making of steel drums for tar and bitumen. The factory, which has been furnished on the most modern lines, is an exact copy of one in France, and it is claimed that there is not a similar one in Britain. The requirements of the Irish Free State for steel drums of the type being turned out is very considerable.

COMPETITION AMONG BUYERS, particularly Japanese shipbreakers, has been very keen in the universal search for scrap iron. Messrs. Metal Industries, Limited, Glasgow, has bought the steamer "Corrigan Head," which was owned by Messrs. G. Heyn & Son, of Belfast, for about £5,000. The vessel will be broken up at the firm's yard at Rosyth. Metal Industries, Limited, are at present breaking up another Heyn steamer, the "Lord Antrim," which they bought recently, at Rosyth.

MESSRS. BABCOCK & WILCOX, LIMITED, have secured a contract for boiler plant required for new sulphate cellulose works at Vuokfeimisha, Finland. The amount of the contract is in the vicinity of £120,000, and a large amount of the work will be executed at the Renfrew establishment. The order has been secured in competition with a number of German and Swiss firms, and the successful issue to the tender has been considerably influenced by the trade agreement effected between this country and Finland recently.

THE CALEDON SHIPBUILDING & ENGINEERING COMPANY, LIMITED, Dundee, which is now celebrating its 60th year in the industry, has issued an interesting brochure illustrative of the firm's activities. Established in 1874, the company can boast of having produced an average of six vessels in each year of its history. During the years 1928-33 the firm's output amounted to 30 vessels totalling over 122,000 tons gross. The firm was the first in Scotland to take out a licence for the production of castings by the Perlit process.

THE DIRECTORS of the Lion Foundry Company, Limited, Kirkintilloch, met those of their employees who have had over 50 years' service with the firm on June 15, and made suitable presentations to them to commemorate the occasion. The six recipients were :—Mr. Robert Buchanan, Birmingham traveller, with 52 years of service; Mr. Walter King, cashier, 51 years; Mr. William Gray, chief clerk, 51 years; Mr. Andrew Stark, foreman moulder, 50 years; and Mr. William Graham and Mr. Alexander Murray, ironmoulders, each with 50 years. Together they totalled over 300 years of service.

TO MARK THE OPENING of another extension of the Cannerton brickworks at Dennyloanhead, Mrs. James Anderson, wife of the managing director, entertained the workers to lunch in the works canteen on June 11. Two mines have been opened for the working of a fireclay seam where formerly coal was worked. It is intended to market the raw clay as well as grinding it locally. Analysis has shown that the fireclay is of a specially good quality, being very high in silica and alumina, which will render it valuable for steelworks, foundries and gas retorts. The seam is 6 ft. thick. A new haulage road and scaffolding has been constructed from the mine to the brickworks, and new engine and boiler installed to cope with the extra work.

A CASE OF CONSIDERABLE INTEREST to founders came before Sheriff Brown in Hamilton Sheriff Court this week, when compensation was awarded to Mrs. Catherine Lucindo Wilson, or McDade, Robert McDade and Henry McDade, of Blantyre, against the Steel Company of Scotland, Limited, Hallside Works, Newton. The claimants were the widow and children of Edward McDade, who died on January 17, 1933, and who for about 16 years was employed by the defendants as a sand-blast operator. As from June 2, 1931, the now deceased had been certified to be suffering from silicosis, accompanied by tuberculosis, and to be thereby totally disabled from work. The question to be decided, his Lordship stated in a note, was whether the process in which the deceased was employed was one to which the Various Industries (Silicosis) Scheme, 1931, applied. By Section 2 it was provided that the scheme should apply to the freeing of steel castings from adherent sand or other siliceous substances, excepting work done upon the foundry floor. It was maintained for the defenders that the work was done upon the foundry floor, and that therefore the exception applied. One part of the process was done in what was known as a sand-blast chamber. The floor of the chamber was level with the foundry floor, but it was an entirely separate building from the other buildings under the foundry roof. During the process the chamber was filled with clouds of very fine dust. It was true that elaborate precautions were taken to protect the workmen from the risk of contracting silicosis. His Lordship had no doubt that those precautions were very well devised, but there could be no guarantee that they would always be effective. In his opinion, the true conclusion on the evidence was that what was done in the sand-blast chamber was not "work done upon the foundry floor," and it followed that the exception did not apply.

Company Reports

Callender's Cable & Construction Company, Limited.—Final dividend of 10 per cent. on the ordinary shares, making 15 per cent. for the year.

Zinc Corporation, Limited.—Participating dividend of 9d. per share on both the preference and ordinary shares, making a total of 1s. 3d. in respect of 1933.

Brightside Foundry & Engineering Company, Limited.—Directors have decided to pay on July 1 the dividend on the preference shares for the three years to June 30 last.

Consett Iron Company, Limited.—Brought in, £90,413; adjustment for debenture interest for the three months to March 31, 1933, £12,500; profit for period to March 31 last, £191,493; interest on debenture stock, £100,000; depreciation, £100,000; carried forward, £94,406.

Contracts Open

Yeovil, July 2.—6-in. cast-iron mains and specials, etc., for the Town Council. Mr. A. J. Price, water engineer, Municipal Offices, Yeovil.

Aldeburgh, June 25.—4-in. cast-iron water main, 2,600 ft. in extent, for the Town Council. Mr. P. R. Bradley, borough surveyor, Town Hall, Aldeburgh.

South Africa, July 16.—26 steam locomotives, for the South African Railways and Harbours. The Department of Overseas Trade. (Reference G.Y. 13,897.)

Hinderwell, July 4.—900 yds. of 4-in. spun-iron pipes, 7,000 yds. 3-in. cast-iron pipes, etc., for the Whitby Rural District Council. Messrs. F. J. Rodwell & Son, 37, Prudential Buildings, Park Row, Leeds. (Fee £2 2s., returnable.)

Personal

ON THE OCCASION of his marriage, Mr. Frank McKenna received a presentation clock from his fellow-employees in the dressing shop of Messrs. Cruikshank & Company, Limited, Denny Iron Works, at the luncheon interval on June 14.

MANY MESSAGES OF CONGRATULATION have been received by Mr. and Mrs. Alexander Paterson, of Chapel Buildings, Bonnybridge, who, on June 13, celebrated their golden-wedding anniversary. Mr. Paterson retired about a year ago, after having worked as an ironmoulder in Messrs. Smith & Wellstood's, Limited, for 60 years.

MR. AND MRS. WILLIAM MUIR, Camp Street, Motherwell, celebrated the 50th anniversary of their marriage on June 11. They have resided in Motherwell for over 34 years, and for over 32 years Mr. Muir was employed with Messrs. Colville, Limited, Dalzell Steel Works, retiring from the position of foreman of the gas-producer plant about two years ago.

MR. W. WALKER, of Stirling, has been appointed chief engineer of the Staveley Company's foundries, near Chesterfield, Derbyshire. He served his apprenticeship at Greenock, and went to sea for some years, after which he gained his Chief's certificate. He subsequently held positions with Metropolitan-Vickers Electrical Company and with Messrs. Brown, Boveri, engineers.

MR. R. R. STOKES, managing director of Messrs. Cochran & Company (Annan), Limited, and chairman of Messrs. Ransomes & Rapier, Limited, of Ipswich, has just returned from a visit to Moscow, in which he was successful in securing an order for excavators to be built by Messrs. Ransomes & Rapier, the boilers for which will be built at Newbie Engineering Works, Annan.

A FAMILIAR FIGURE in steel construction and bridge building throughout Scotland disappears from active circles by the retirement of Mr. William McKay, chief steelwork inspector, Divisional Engineers' Office, L.M.S., Glasgow. Mr. McKay had completed 43 years' service with the old Caledonian and L.M.S. Companies, and at a gathering under the chairmanship of Mr. A. H. McMurdo, divisional engineer, Mr. McKay was presented with parting gifts from colleagues and friends by Mr. J. W. F. Gardner.

Wills

CONNELL, WILLIAM CUTHBERT SMITH, Craigallion, Milngavie, Dumbartonshire, and of the Scotstoun Shipbuilding Yard £497,360

SANDEMAN, J. C. S., of Edinburgh, chairman of Messrs. Brown Bros. & Company, Limited, Rosebank Ironworks, Edinburgh £5,244

Obituary

MR. ROBERT ALLAN, who had been employed with the North British Railway Company and the L.N.E.R. works at Cowlairs for over 50 years, has died suddenly. He was in his 78th year.

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Bersham Foundry, Limited, Rhostyllen, Wrexham.—Capital £1,000. Directors: R. Edwards and R. Roberts.

Sprayed Metal Coverings (Burnley), Limited.—Capital £500. Directors: W. Redfern, 119, Albion Street, Burnley; Mrs. S. A. Redfern.

Dilworth & Morris, Limited.—Capital £1,000. Engineers, machinery manufacturers, etc. Directors: J. Dilworth, 38, Buxton Road, New Mills, Derbyshire; F. Morris.

Manchester Furnaces (1934), Limited, Globe Works, 462, Ashton New Road, Manchester, 11.—Capital £2,000. Furnace and combustion engineers. Directors: G. Evans, E. Wilson and W. Hammond.

Kemetals, Limited, 25, Brazennose Street, Manchester.—Capital £500. To acquire the manufacturing rights of certain secret processes for treating metals with the object of eliminating or removing the effects of oxidisation. Directors: W. Kaldauke, R. Dowling, E. Stock and H. Ehrenfried.

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Raw Material Markets

Although actual business has been rather quieter, owing to seasonal influences, the strength of the market is fully maintained. Order-books in most sections of the iron and steel industry are well filled, and the May production showed an increase as compared with April. The May output of pig-iron was, indeed, the highest for some time.

Pig-Iron

MIDDLESBROUGH.—There are now 28 blast furnaces at work in this area, a furnace on ferro-silicon having been stopped. The market in Cleveland foundry iron is rather quiet at the moment, but consumers have recently bought heavily and the makers have sufficient work on hand to last them for at least a month or two. Little export business is available, in spite of offers at very low prices. The fixed minimum scale for all sales to home consumers is regulated by No. 3 Cleveland G.M.B. at 67s. 6d. per ton delivered Middlesbrough, 69s. 6d. delivered North-East Coast, 67s. 3d. delivered Falkirk and 70s. 3d. delivered Glasgow. Half-a-crown extra is charged for No. 1 foundry grade, and No. 4 foundry and No. 4 forge are each quoted 1s. per ton less than the price of No. 3.

There is a sustained demand for East Coast hematite. Shipments have now been resumed to South Wales and, with local and other outlets showing no sign of contraction, the outlook is quite favourable. It would be even more so were export business less limited, but, unfortunately, apart from Denmark, there is little overseas demand for British iron. Home prices are unchanged, No. 1 quality being still quoted at 68s. per ton delivered Middlesbrough, 70s. delivered North-East Coast, 74s. to 77s. delivered Yorkshire and 79s. delivered Birmingham.

LANCASHIRE.—A fair number of replacement contracts has come on to the market during the past fortnight, and this movement should develop more strongly by next month. An encouraging feature of the present situation is that consumers' commitments are expiring at about the due dates, instead of overrunning them by a number of weeks, as happened formerly. The price position is quite steady. Derbyshire, Staffordshire and Cleveland irons are quoted for delivery in the Lancashire zone at 74s. per ton, with Northamptonshire foundry at 72s. 6d. Lancashire foundry iron is quoted at 74s. and 72s. 6d. per ton respectively, for qualities equal to Derbyshire and Northants, delivered Lancashire zone. The demand for Scottish makes is poor, with offers for delivery equal to Manchester at about 82s. 6d. per ton.

MIDLANDS.—There has not been much forward buying of Midland pig-irons during the past week, but the situation in this respect should improve with the turn of the month. The light-castings trade continues to be very well occupied, whilst conditions are slowly improving in the general-engineering section. Prices are unchanged; the controlled rates, including delivery to Birmingham and Black Country stations, are 67s. 6d. for Northants No. 3 and 71s. per ton for Derbyshire, Staffordshire and Lincolnshire No. 3, subject to a graduated rebate for large consumers. Special refined iron varies in price, according to analysis and tonnage, and is anything from £5 15s. to £6 15s. per ton. Scottish No. 3 is 85s. to 87s. 6d., with other low-phosphorus iron from 81s. to 85s. per ton, and irons with medium-phosphorus content 70s. to 80s. per ton delivered South Staffordshire area.

SCOTLAND.—The demand for Scottish foundry iron is sluggish, and is limited almost entirely to consumers' current needs. Prices are unaltered at 70s. for No. 3 at furnaces, with 2s. 6d. extra for No. 1. The Falkirk foundry industry remains very busy, and continues to consume large quantities of Cleveland iron. The latter is quoted at 67s. 3d. for No. 3 at Falkirk and 70s. 3d. at Glasgow.

Coke

The foundry-coke market remains very firm, and many consumers have taken the precaution of buying before a possible advance in prices takes place. Current quotations in the Birmingham area are as follow:—Best Durham coke, 36s. 6d. to 40s.; other grades, about 2s. less; Welsh coke, 37s. 6d. to 45s.; Scottish coke, 41s. to 42s.

Steel

Summer trading conditions continue to rule, but the volume of business is at a much higher level than is usual at this period. In the semi-finished steel department business has become quieter, and some of the works which a short time ago were working practically at capacity are not now so well employed and are looking for new business to take the place of orders which are being worked off. Latterly there has been a fair amount of business done in foreign semi-finished steel; but the quantities have not been important. In fact, only a small proportion of the business coming on the market goes abroad, although comparatively cheap prices are quoted for Continental material. Business in finished steel has been irregular of late, but most of the works carry good order-books, and the present slackening in demand is regarded as being of a seasonal character. Export business has shown some improvement recently, although the bulk of the demand is still upon home account.

Scrap

In the Cleveland market a steady trade continues to be done in cast-iron scrap, at unchanged figures. There has been no change in conditions in the Midlands, where average quotations are 55s. for machinery metal in handy sizes, 50s. for clean pipe and plate scrap and 47s. 6d. for clean light cast iron, all delivered works. An improving demand for some grades of scrap iron is reported from South Wales, where 47s. 6d. to 48s. 6d. is paid for heavy cast iron, and 42s. to 44s. for light cast-iron scrap. South Wales, however, is still a poor market for good machinery scrap in foundry sizes, and only small parcels are being sold, at about 50s. to 52s. 6d. per ton. In Scotland, heavy machinery scrap is quoted at 55s. and ordinary cast-iron scrap at 53s. per ton.

Metals

Copper.—Consumption of copper in this country is maintained at a fairly good level, but similar conditions cannot be said to prevail throughout Europe. Trade with Germany has been very limited, and the declaration of a debt moratorium by that country has not helped matters. The outlook in the United States has slightly improved, following on the temporary postponement of the threatened strike in the steel industry. The American brass and copper mills have been fairly well engaged for some time.

Daily quotations :—

Cash.—Thursday, £32 10s. to £32 11s. 3d.; Friday, £32 1s. 3d. to £32 3s. 9d.; Monday, £32 2s. 6d. to £32 3s. 9d.; Tuesday, £32 5s. to £32 6s. 3d.; Wednesday, £32 1s. 3d. to £32 2s. 6d.

Three Months.—Thursday, £32 16s. 3d. to £32 17s. 6d.; Friday, £32 7s. 6d. to £32 10s.; Monday, £32 8s. 9d. to £32 10s.; Tuesday, £32 11s. 3d. to £32 12s. 6d.; Wednesday, £32 7s. 6d. to £32 8s. 9d.

Tin.—A feature has been the recent disappearance of the backwardation, the nearer position having been relieved by the arrival in Liverpool warehouses of 600 tons of Dutch tin. Demand on the part of consumers has fallen off both in this country and on the Continent, whilst in the United States of America, though at times more activity was reported, business on the whole continues dull. The weakness, therefore, must be very largely ascribed to the quiet conditions prevailing in consuming industries, which by some is regarded as an indication that consumption for the time being may have reached its peak, particularly having in view the uncertainties which still surround the labour situation in America, report Messrs. Rudolf Wolff.

Market prices :—

Cash.—Thursday, £224 5s. to £224 10s.; Friday, £222 15s. to £223 10s.; Monday, £222 5s. to £222 10s.; Tuesday, £225 10s. to £225 15s.; Wednesday, £226 2s. 6d. to £226 5s.

Three Months.—Thursday, £224 5s. to £224 10s.; Friday, £222 15s. to £223; Monday, £222 10s. to £222 15s.; Tuesday, £225 15s. to £226; Wednesday, £226 7s. 6d. to £226 10s.

Spelter.—A sharp fall in quotations took place last week, the only apparent cause being the increase of 1,300 tons in Cartel stocks which took place during May. The usual rumours have been circulating as to the possibility of the Cartel being dissolved, but this is extremely unlikely.

Day-by-day prices :—

Ordinary.—Thursday, £14 6s. 3d.; Friday, £14; Monday, £14; Tuesday, £14; Wednesday, £14.

Lead.—The lead market has maintained a very steady tone. The general situation is against an advance in prices at the present moment.

Market fluctuations :—

Soft Foreign (Prompt).—Thursday, £11; Friday, £11; Monday, £11 1s. 3d.; Tuesday, £11 1s. 3d.; Wednesday, £11 1s. 3d.

Future of Palmers, Hebburn

After months of rumour and false alarms it is learned officially that the shipbuilding and engineering works of Palmers Shipbuilding & Iron Company, Limited, Jarrow-on-Tyne, and the shipyard of Palmer's Hebburn Company have been acquired by National Shipbuilders' Security, Limited, for dismantling as redundant. Jarrow is left now with only the Mercantile Dry Dock Company, Limited, to provide employment for its inhabitants, 90 per cent. of whom are unemployed.

The firm's dry dock at Hebburn, however, is to be carried on as usual, and a new company, also named Palmers Hebburn Company, has been formed to run the dock and engine works. The directors will be Mr. E. L. Champness (managing director), Mr. F. C. Pyman (of Messrs. W. Gray & Company, Limited, shipbuilders, West Hartlepool), and Col. D. R. MacDonald (late general manager of the Palmers Company. Col. MacDonald started his career with Denny Bros, Dumbarton, and joined Palmers in 1926.

The Jarrow yard of Messrs. Palmers was started 83 years ago by the late Sir Charles Mark Palmer, and during its career built 1,007 vessels, representing 3,320,000 gross tons, including many warships. In 1930 Messrs. Palmers launched from the Hebburn yard the "Peter Hurll," the 1,000th vessel built by the firm.

Palmers were the first firm to use rolled armour plates instead of forged plates in warship construction, this method being adopted by Sir Charles Palmer many years ago. They also built the "John Bowes," the first iron-screw collier, which foundered only last year after being in service for 80 years. The passing of Palmers yards at Jarrow and Hebburn means that 12 shipbuilding berths will be dismantled and one dry dock at Jarrow, 440 ft. long, will probably be scrapped.

In prosperous days Palmers employed 10,000 workmen, but for three years they have not built a single vessel, and for two years have been in the hands of a Receiver. The Palmers Hebburn dock is 700 ft. long—the biggest on the North-East Coast—and has been the scene of many interesting repair jobs. Notable among them were the "Saranac" and the "Cadillac," tankers of 12,000 tons each, which had new centres fitted, 300 ft. long. Satisfaction is felt at Hebburn that at least a section of Palmers is to be kept going, but at Jarrow the outlook has never been more hopeless since the town sprang into its industrial existence over 80 years ago.

Electrochemical Estimation of Sulphur in Steels, etc.

In Report No. 99 of the chemical sub-committee of the Verein deutscher Eisenhüttenleute, G. THANHEISER and P. DICKENS discuss the estimation of sulphur in iron, steel, ferro-alloys, slags and ores by the electrochemical method which eliminates many of the difficulties encountered in Holthaus's method, and also allows more dilute solutions to be used, thus giving a higher accuracy. Holthaus dissolves the sulphuric acid formed in caustic soda, while the authors titrate the acid directly against alkali. The method is also adapted to S estimations in slags and ores, but cannot be applied in the presence of fluorine unless certain precautions are taken. The water content in ores does not affect the accuracy of the method. The Report is published in the "Archiv für das Eisenhüttenwesen."

XUM

Genuine All-Mine Cold Blast Pig Iron - - - - -

PERFECT FOR HEAVY CASTINGS

FOR CHILLED ROLLS, CYLINDERS, CYLINDER LINERS, COG WHEELS FOR ROLLING MILLS, BOTTOM PLATES FOR MORTAR MILLS, AND ALL HIGH GRADE CASTINGS REQUIRING UNIFORMITY, DURABILITY, STRENGTH OR TOUGHNESS AND RESISTANCE TO GROWTH UNDER HEAT.

MAKERS & BRANDS:

THE EARL OF DUDLEY'S ROUND OAK WORKS, LTD.
BRIERLEY HILL, STAFFS.
Brand: "DUD.L.N.F'ces·DUD"

M. & W. GRAZEBROOK, LIMITED
DUDLEY, WORCS.
Brand: "GRAZEBROOK"

THE LOW MOOR IRON CO., LTD.,
NEW WORKS, LOW MOOR
BRADFORD - YORKSHIRE
Brand: "LOWMOOR C.B."

FAMOUS FOR CENTURIES

RAW MATERIALS—PRICE LIST

(Wednesday, June 20, 1934)

COPPER

	£	s.	d.
Standard cash	32	1	3
Three months	32	7	6
Electrolytic	35	5	0
Tough	34	0	0
Best selected	34	0	0
Sheets	62	0	0
India	44	15	0
Wire bars	35	15	0
Ingot bars	35	15	0
H.C. wire rods	38	7	6
Off. av. cash, May	32	14	$0\frac{9}{11}$
Do., 3 mths., May	32	19	$2\frac{3}{11}$
Do., Sttlmnt., May	32	13	$11\frac{5}{11}$
Do., Electro, May	35	19	$2\frac{5}{11}$
Do., B.S., May	35	16	$11\frac{1}{2}$
Do., wire bars, May	36	3	$3\frac{6}{11}$
Solid drawn tubes			10d.
Brazed tubes			10d.
Wire			$6\frac{1}{2}$d.

BRASS

Solid drawn tubes	9d.
Brazed tubes	11d.
Rods, drawn	$8\frac{1}{2}$d.
Rods, extd. or rlld.	$4\frac{1}{2}$d.
Sheets to 10 w.g.	$7\frac{1}{2}$d.
Wire	$7\frac{1}{2}$d.
Rolled metal	7d.
Yellow metal rods	$4\frac{1}{2}$d.
Do. 4 × 4 Squares	$5\frac{1}{2}$d.
Do. 4 × 3 Sheets	$5\frac{1}{4}$d.

TIN

	£	s.	d.
Standard cash	226	2	6
Three months	226	7	6
English	226	17	6
Bars	228	5	0
Straits (nom.)	226	15	0
Australian (nom.)	—		
Eastern	224	15	0
Banca (nom.)	—		
Off. av. cash, May	234	7	$8\frac{1}{2}$
Do., 3 mths., May	231	1	$6\frac{9}{11}$
Do., Sttlmt., May	234	7	6

SPELTER

	£	s.	d.
Ordinary	14	0	0
Remelted	14	10	0
Hard	11	10	0
Electro 99.9	16	12	6
English	14	12	6
India	13	10	0
Zinc dust	16	15	0
Zinc ashes	3	2	6
Off. aver., May	14	16	$10\frac{1}{2}$
Aver. spot, May	14	14	$5\frac{3}{11}$

LEAD

	£	s.	d.
Soft foreign ppt.	11	1	3
Empire (nom.)	11	11	3
English	12	15	0
Off. average, May	11	3	$11\frac{1}{22}$
Average spot, May	11	1	$0\frac{5}{11}$

ALUMINIUM

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	23	5	0
Do., V.M. ex whse.	22	10	0
Rods	28	0	0

ANTIMONY

	£	s.	d.		£	s.	d.
English	40	0	0	to 43	0	0	
Chinese, ex-whse.					32	0	0
Crude					24	10	0

QUICKSILVER

	£	s.	d.		£	s.	d.
Quicksilver	11	2	6	to 11	10	0	

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—	
25%	£8 17 6
45/50%	£13 0 0
75%	£18 7 6
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% carbon-free of Mo.	5/6 per lb.
Ferro-titanium—	
23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£14 10 0
Ferro-tungsten—	
80/85%	3/3 lb.
Tungsten metal powder—	
98/99%	3/6 lb.
Ferro-chrome—	
2/4% car.	£29 15 0
4/6% car.	£23 0 0
6/8% car.	£21 12 6
8/10% car.	£21 12 6
Ferro-chrome—	
Max. 2% car.	£36 0 0
Max. 1% car.	£38 15 0
Max. 0.70% car.	£42 0 0
70% carbon-free	10d. lb.
Nickel—99.5/100%	£200 to £205
"F" nickel shot	£180 0 0
Ferro-cobalt, 98/99%	5/2 lb.
Metallic chromium—	
96/98%	2/5 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export	(nom.) £9 15 0
Metallic manganese—	
94/96% carbon-free	1/2 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under $\frac{1}{2}$ in. to $\frac{1}{4}$ in.	3d. lb.
Do., under $\frac{1}{4}$ in. to $\frac{1}{16}$ in.	1/– lb.
Flats, $\frac{1}{2}$ in. × $\frac{1}{4}$ in. to under 1 in. × $\frac{1}{8}$ in.	3d. lb.
Do., under $\frac{1}{4}$ in. × $\frac{1}{4}$ in.	1/– lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP

	£	s.	d.		£	s.	d.
South Wales—							
Heavy steel					2	15	0
Bundled steel and shrngs.					2	7	6
Mixed iron and steel					2	10	0
Heavy cast iron	2	7	6	to 2	8	6	
Good machinery	2	10	0	to 2	12	6	
Cleveland—							
Heavy steel	2	10	0	to 2	12	6	
Steel turnings					1	17	6
Cast-iron borings					1	7	6
Heavy forge					2	10	0
W.I. piling scrap					2	5	0
Cast-iron scrap	2	12	6	to 2	15	0	
Midlands—							
Light cast-iron scrap					2	7	6
Heavy wrought iron					3	0	0
Steel turnings, f.o.r.					1	13	0
Scotland—							
Heavy steel	2	10	0	to 2	11	0	
Ordinary cast iron					2	13	0
Engineers' turnings					2	0	0
Cast-iron borings	1	18	6	to 2	0	0	
Wrought-iron piling					2	11	3
Heavy machinery					2	15	0

London—Merchants' buying prices, delivered yard.

	£	s.	d.		£	s.	d.
Copper (clean)					26	0	0
Brass					19	0	0
Lead (less usual draft)					10	0	0
Tea lead					7	5	0
Zinc					9	10	0
New aluminium cuttings					69	0	0
Brassiery copper					23	0	0
Gunmetal					24	10	0
Hollow pewter					150	0	0
Shaped black pewter					110	0	0

PIG-IRON

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	70/–
Foundry No. 3	67/6
,, at Falkirk	67/3
,, at Glasgow	70/3
Foundry No. 4	66/6
Forge No. 4	66/6
Hematite No. 1	68/–
Hematite M/Nos.	67/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	72/6
,, d/d Birm.	84/6
Malleable iron d/d Birm.	115/–
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	67/–
,, No. 3 fdry.	71/–
Northants forge	63/6
,, fdry. No. 3	67/6
,, fdry. No. 1	70/6
Derbyshire forge	67/–
,, fdry. No. 3	71/–
,, fdry. No. 1	74/–
Scotland—	
Foundry No. 1, f.o.t.	72/6
,, No. 3, f.o.t.	70/–
Hem. M/Nos. d/d	71/–
Sheffield (d/d district)—	
Derby forge	64/6
,, fdry. No. 3	68/6
Lincs forge	64/6
,, fdry. No. 3	68/6
E.C. hematite	80/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	74/–
Staffs fdry. No. 3	74/–
Northants fdry. No. 3	72/6
Cleveland fdry. No. 3	74/–
Dalzell, No. 3 (special)	102/6 to 105/–
Glengarnock, No. 3	82/6
Clyde, No. 3	82/6
Monkland, No. 3	82/6
Summerlee, No. 3	82/6
Eglinton, No. 3	82/6
Gartsherrie, No. 3	82/6
Shotts, No. 3	82/6

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

Iron—	£	s.	d.		£	s.	d.
Bars (cr.)	9	12	6	to 9	15	0	
Nut and bolt iron	7	10	0	to 8	0	0	
Hoops	10	10	0	to 12	0	0	
Marked bars (Staffs) f.o.t.				12	0	0	
Gas strip	10	10	0	to 12	0	0	
Bolts and nuts, $\frac{3}{4}$ in. × 4 in.				14	0	0	
Steel—							
Plates, ship, etc.	8	15	0	to 8	17	6	
Boiler plts.	8	2	6	to 8	10	0	
Chequer plts.				10	7	6	
Angles				8	7	6	
Tees				9	7	6	
Joists				8	15	0	
Rounds and squares, 3 in. to $5\frac{1}{2}$ in.				9	7	6	
Rounds under 3 in. to $\frac{3}{8}$ in. (Untested)				8	12	0	
Flats—8 in. wide and over				8	12	6	
,, under 8 in. and over 5 in.				8	17	6	
Rails, heavy	8	5	0	to 8	10	0	
Fishplates	12	5	0	to 12	10	0	
Hoops (Staffs)				9	7	0	
Black sheets, 24g. (4-t. lots)				10	10	0	
Galv. cor. shts. (,,)				13	0	0	
Galv. flat shts. (,,)				12	10	0	
Galv. fencing wire, 8g. plain				14	10	0	
Billets, soft				5	10	0	
Billets, hard	6	17	6	to 7	2	6	
Sheet bars	5	0	0	to 5	5	0	
Tin bars				5	0	0	

PHOSPHOR BRONZE

	Per lb. basis.
Strip	11d.
Sheet to 10 w.g.	12d.
Wire	12d.
Rods	11d.
Tubes	15d.
Castings	13d.

Delivery 3 cwt. free.

10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.

C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	$1/1\frac{1}{2}$ to $1/7\frac{1}{2}$
To 15 in. wide	$1/1\frac{1}{2}$ to $1/7\frac{1}{2}$
To 18 in. wide	1/2 to 1/8
To 21 in. wide	$1/2\frac{1}{2}$ to $1/8\frac{1}{2}$
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to $1/3\frac{1}{2}$
Ingots rolled to spoon size	10d. to $1/6\frac{1}{2}$
Wire round—	
to 10g.	$1/4\frac{1}{2}$ to $1/11\frac{1}{2}$

with extras according to gauge.

Special 5ths quality turning rods in straight lengths, $1/3\frac{1}{2}$ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	20.26
No. 2 foundry, Valley	18.50
No. 2 foundry, Birm.	14.00
Basic, Valley	18.00
Bessemer	20.76
Malleable, Valley	18.50
Grey forge, Valley	17.50
Ferro-mang. 80%, seaboard	85.00
O.-h. rails, h'y, at mill	36.37½
Billets	29.00
Sheet bars	30.00
Wire rods	38.00
	Cents.
Iron bars, Phila.	1.94
Steel bars	1.90
Tank plates	1.85
Beams, etc.	1.85
Skelp, grooved steel	1.70
Steel hoops	2.10
Sheets, black, No. 24	2.65
Sheets, galv., No. 24	3.25
Wire nails	2.60
Plain wire	2.30
Barbed wire, galv.	3.00
Tinplates, 100-lb. box	$5.25

COKE (at ovens)

Welsh foundry	25/– to 30/–
,, furnace	20/–
Durham foundry	21/– to 25/–
,, furnace	17/6
Midlands, foundry	—
,, furnace	—

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box		17/3 to 17/6
,,	28×20	,,	34/6 to 35/–
,,	20×10	,,	24/9 to 25/–
,,	$18\frac{1}{2}$×14	,,	18/– to $18/1\frac{1}{2}$
C.W.	20×14	,,	15/6
,,	28×20	,,	32/6
,,	20×10	,,	22/–
,,	$18\frac{1}{2}$×14	,,	15/6

SWEDISH CHARCOAL IRON & STEEL

Pig-iron	£6	0	0	to £7	0	0
Bars-hammered, basis	£16	0	0	to £16	10	0
Bars and nail-rods, rolled, basis	£15	15	0	to £16	0	0
Blooms	£10	0	0	to £12	0	0
Keg steel	£30	0	0	to £31	0	0
Faggot steel	£18	0	0	to £23	0	0
Bars and rods dead soft, st'l	£10	0	0	to £12	0	0

All per English ton, f.o.b. Gothenburg.

[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

		£	s.	d.	
June	14 ..	32	10	0 dec.	6/3
„	15 ..	32	1	3 „	8/9
„	18 ..	32	2	6 inc.	1/3
„	19 ..	32	5	0 „	2/6
„	20 ..	32	1	3 dec.	3/9

Electrolytic Copper

		£	s.	d.	
June	14 ..	35	15	0 dec.	5/-
„	15 ..	35	5	0 „	10/-
„	18 ..	35	5	0 No change	
„	19 ..	35	5	0 „	„
„	20 ..	35	5	0 „	„

Standard Tin (cash)

		£	s.	d.	
June	14 ..	224	5	0 dec.	40/-
„	15 ..	222	15	0 „	30/-
„	18 ..	222	5	0 „	10/-
„	19 ..	225	10	0 inc.	65/-
„	20 ..	226	2	6 „	12/6

Tin (English ingots)

		£	s.	d.	
June	14 ..	224	15	0 dec.	40/-
„	15 ..	223	10	0 „	25/-
„	18 ..	223	0	0 „	10/-
„	19 ..	226	5	0 inc.	65/-
„	20 ..	226	17	6 „	12/6

Spelter (ordinary)

		£	s.	d.	
June	14 ..	14	6	3 dec.	3/9
„	15 ..	14	0	0 „	6/3
„	18 ..	14	0	0 No change	
„	19 ..	14	0	0 „	„
„	20 ..	14	0	0 „	„

Spelter (Electro, 99.9 per cent.)

		£	s.	d.	
June	14 ..	16	18	9 dec.	5/-
„	15 ..	16	12	6 „	6/3
„	18 ..	16	12	6 No change	
„	19 ..	16	12	6 „	„
„	20 ..	16	12	6 „	„

Zinc Sheets (English)

		£	s.	d.	
June	14 ..	23	10	0	No change
„	15 ..	23	10	0	„ „
„	18 ..	23	10	0	„ „
„	19 ..	23	5	0 dec.	5/-
„	20 ..	23	5	0	No change

Lead (English)

		£	s.	d.	
June	14 ..	12	15	0	No change
„	15 ..	12	15	0	„ „
„	18 ..	12	15	0	„ „
„	19 ..	12	15	0	„ „
„	20 ..	12	15	0	„ „

Imports and Exports of Pig-Iron, Iron and Steel Castings, etc., in May and the five months, 1934, compared with a year ago.

	May.		Five months.		May.		Five months.	
	1933.	1934.	1933.	1934.	1933.	1934.	1933.	1934.
	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Imports.								
Pig-iron, forge	—	—	—	—	—	—	—	—
„ foundry	4,569	4,221	15,911	16,985	14,042	12,039	53,140	48,457
„ acid	—	—	37	—	—	—	226	—
„ basic	4,500	10,751	19,146	30,667	12,213	28,939	51,112	82,027
Total (including other kinds)	9,069	15,346	35,094	53,274	26,255	43,482	104,478	163,967
Castings and forgings	145	538	504	1,568	3,160	14,301	11,669	38,992
Cast pipes and fittings	196	93	662	570	2,814	4,633	11,872	31,148
Stoves, grates, etc.	66	71	284	343	4,774	6,817	26,342	33,703
Baths	513	689	1,805	3,420	11,678	17,140	41,820	81,886
Hollow-ware, all kinds	158	212	778	1,018	6,889	12,494	34,543	56,736
Exports.								
Pig-iron, forge	151	100	879	462	539	385	3,431	1,875
„ foundry	3,753	6,409	17,021	28,895	14,740	22,380	61,305	97,718
„ acid	8,174	4,540	22,192	20,141	25,774	14,270	68,848	63,617
„ basic	65	113	810	778	231	377	3,206	2,523
Total	12,143	11,162	40,902	50,276	41,284	37,412	136,790	165,733
Castings and forgings	253	364	1,070	2,083	9,900	13,583	44,207	77,464
Cast pipes and fittings, up to 6 in. diameter	4,816	6,163	19,527	25,617	50,119	68,418	212,340	283,905
„ „ „ over 6 in. „	2,333	2,446	11,187	17,107	17,393	20,550	80,778	128,270
Stoves, grates, etc.	602	684	2,606	3,488	30,269	32,424	121,262	165,584
Sanitary cisterns	213	261	987	1,201	6,163	7,806	29,293	35,080
Bedsteads, inc. tubes therefor	315	443	1,678	2,185	11,999	14,394	63,777	72,014
Cast hollow-ware	278	229	1,610	1,368	11,794	10,496	65,642	52,827

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Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

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Sand Mills, 6-ft., 5-ft. and 4-ft. 6-in. dia. Pans.

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COMPRISING A TOTAL AREA OF 20,900 SQUARE YARDS
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There is a frontage to Canal Basin of about 1,000 ft. The distance from the L.M. & S. and G.W.R. Goods Stations at Great Bridge is ¼-mile, and services include South Staffs and Canal Water Supplies, Gas and Electric Light and Power.

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PATENT

THE Proprietors of the Patent No. 226,751, for "Improvements in or relating to Processes for Incorporating Manganese with Iron," are desirous of entering into arrangements by way of licence and otherwise on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country.—All communications should be addressed in the first instance to Haseltine, Lake & Company, 28, Southampton Buildings, Chancery Lane, London, W.C.2.

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With one exception Peter is an ordinary little fellow. Chubby, likeable, just five-and-a-half, full of life and fun and on occasions—be it admitted—of naughtiness.

Just now Peter's rather important, for this is his first term at school, and he's grappling with the intricacies of "A B C" and "Twice-Two": difficult subjects to all men of five-and-a-half, but even more difficult in Peter's case because—bad luck—he's totally blind. That's his One Exception.

Peter learns reading, writing, and 'rithmetic through the medium of "Braille"—dull stuff compared with the coloured picture books of most five-and-a-halfs. However, he's a stout lad is Peter, and he's making great progress.

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There is a long waiting list of "Peters" throughout the British Isles, for whom training and accommodation must be provided in the immediate future.

Will you help with a donation or annual subscription? Any sum, large or small, will be gratefully received.

Here's a suggestion. Your eyesight is worth 3d a year to you. Send Peter and his handicapped pals 3d for every year you've had it. Now, please, in case it slips your memory. Good idea?

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